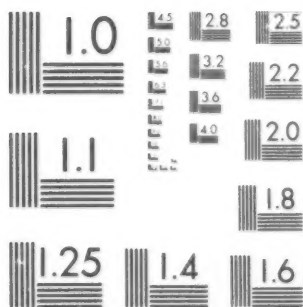


5

Bm



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ED160751

to prevent harm

DE 016 847

2

insurance institute for highway safety

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Insurance Institute
for Highway Safety

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND THE ERIC SYSTEM CONTRACTORS.

3

The Insurance Institute for Highway Safety is an independent scientific organization that identifies, evaluates, and develops ways to reduce the nation's human and economic damage associated with the use of motor vehicles and their crashes. The Institute is nonprofit; its research, demonstration, and educational work is wholly supported by the American Insurance Highway Safety Association, the American Insurers Highway Safety Alliance, the National Association of Independent Insurers Safety Association, and a number of individual insurance companies, which together write most of the nation's automobile insurance.

The Insurance Institute for Highway Safety

Watergate Six Hundred
Washington, D.C. 20037
202/333-0770

Copyright © 1978 by the Insurance Institute for Highway Safety
International Standard Book Number: 0-932016-00-6
Library of Congress Catalog Card Number: 78-58913

Table of Contents

Introduction	1
Programs	5
Board of Directors	61
Staff	65
Films	77
Bibliography	83
Program Index	103

Introduction

Day by day, the movement of people and goods on the highway takes its huge, unnecessary toll—a toll of losses in life, health, and property that is mind-boggling in its magnitude. Highway crashes are associated with more death to young Americans than any other cause. Highway crashes are associated with more permanently crippling spinal cord injury than any other medium of trauma—injury that means lifelong paraplegia or quadriplegia. And even so-called “minor” motor vehicle crashes are associated with staggeringly high amounts of dollar loss.

The losses have been a mounting burden on Americans and their society since the advent of the motor vehicle. The burden has fallen heaviest on the more than two million men, women, and children killed in highway crashes to date, but its pain has been shared by the hundreds of millions crippled or otherwise injured in crashes, and by the loved ones grieving for the dead and maimed. For society, the burden has been felt in the resulting, climbing costs of maintaining emergency medical, hospital, police, court, auto repair, and other facilities required to accommodate the expected daily flow of broken people and damaged property from the highways.

These losses have gone on for decades; much more recent in origin are scientifically-based programs directed first at pinpointing specific causes of those losses, and then at developing effective ways of actually reducing them. The Insurance Institute for Highway Safety is a leader in researching, demonstrating, and communicating both the causes of death, injury, and property loss on the highway, and the

available—yet often unapplied—solutions. As such it is a principal influence in focusing public and governmental attention and action on the specific nature of the many different sources and kinds of highway losses, and on the real alternatives for eliminating or mitigating the damage to people and property they involve.

The Institute's financial support is entirely provided by the nation's motor vehicle property and casualty insurers, through their three principal trade associations and by a number of individual companies. Insurers fund the Institute for two excellent reasons, the first of which is their wanting to do what they can to help lift from the country the horrible annual burden of motor vehicle deaths and injuries. The second reason has been described by Thomas Morrill, a member of the Institute's board of directors from 1959 until 1978 and a former board chairman. In a speech to the Economic Club of Detroit in 1971, he said:

Any means of reducing the losses entering the insurance system lowers our costs, reduces discontent among our customers, and broadens our markets to additional economic levels. The crash loss reduction efforts of automobile insurers, which are growing in scope and effectiveness, are held together by the glue of self-interest—and I know of no stronger glue. There is every reason for the insurers to assert their role in crash loss reduction; it is difficult to conceive of any other form of private enterprise in which the same congruity of public and private interest exists.

Founded in 1959, the Institute in 1968 underwent a fundamental reorientation of its purposes and program. That year the board of directors—company and association executives representing the motor vehicle property and casualty insurance business—determined that the public and insurers needed but did not have the benefit of a strong, independent research effort capable of pushing progress in the field of highway loss reduction. Acting on that determination, the board in 1969 invited Dr. William Haddon, Jr., who previously had been the first head of the federal highway safety program enacted by the Congress in 1966, to become president of the Institute, and in this capacity to redirect the Institute into a program of scientific fact-finding and communication to the public about highway losses and the means available for preventing or reducing them.

As the board intended, the Institute emerged as an expert, multidisciplinary organization, recognized in America and abroad for its unparalleled effectiveness in carrying out both short term and longer range research to identify and help control the causes of human and economic damage on the highway. Haddon has described it as a compact, expert staff "which can, through flexible programming, thoughtful insight, and speedy response to specific needs, exert leverage far out of proportion to its size and budget."

The conceptual framework for the Institute's work is in the tradition of successful programs for reducing the human and economic damage that occurs when people and their property clash with man-made or natural aspects of the environment. It is a framework that demands the identification first of the nature of



each specific kind of loss, and then of a way or ways to effectively reduce it.

Factors susceptible to being affected in ways that will reduce losses may be in the *precrash*, *crash*, or *postcrash* phase. Those in the *precrash* phase involve the initiation of collisions; in the *crash* phase, the production of human or property damage once collisions are underway; and in the *postcrash* phase, the amelioration of damage after crashes.

As can be seen in the diagram below, the Institute's conceptual framework makes it possible to pinpoint and isolate, in each phase of the crash event and in terms of each factor involved, the ways in which the resultant human and economic losses are being generated, and the possibilities for reducing or eliminating them. The Institute's research work, as well as its

Phases	Factors		
	HUMAN	VEHICLE AND EQUIPMENT	ENVIRONMENT
	PRECRASH		
	CRASH		
	POSTCRASH		
RESULTS 			

programs to communicate research concepts and pay-offs, reflects this. For instance:

In the *precrash* phase, the Institute has done extensive work seeking to find means to change human, vehicular, and environmental factors contributing to the initiation of crashes so as to reduce the end-result losses. Institute research in this phase has included work on the use of drugs (including drug alcohol) in relation to driving, on the influence of driver training on fatal crashes, and on the effectiveness of drunk driving "crackdown" enforcement programs on reducing fatal crashes. It has looked closely and for many years at the possibilities for achieving substantial increases in the voluntary use of non-automatic ("active") restraint systems—safety belts and child restraints—by drivers and passengers in America. It has found, in cases that led to manufacturer recall campaigns, design and manufacturing defects in new cars. And it has identified road characteristics associated with disproportionately high frequencies of fatal, off-the-road crashes.

In the *crash* phase, Institute research has looked extensively at the contribution of such vehicle factors as size, passenger compartment characteristics, and restraint systems to the initiation of injuries in crashes, and also has identified opportunities for substantially reducing such injuries—including fatal injuries—through modest, technologically available improvements in motor vehicle design. Among other results, the Institute research and communications effort in this sector has underscored the need for greatly improved automatic ("passive") restraint systems in motor vehicles—systems such as the air bag—and for bumper and associated automobile designs that would eliminate, through efficient handling of impact energy, costly cosmetic and other damage in low-speed automobile collisions of the parking lot and driveway variety. Federal safety requirements already announced reflect these results.

Also in this phase, the Institute has researched and focused public attention on the magnitude, severity, and needlessness of the national roadside hazard problem. This aspect of Institute work, directed at examining and publicizing the role of roadside hazards in aggravating injury to people when their cars momentarily leave the travelled roadway, helped lay the groundwork for government actions—including federal funding authorizations of more than \$1 billion to date—to remove or correct such lethal roadside obstacles as concrete pillars, unyielding sign and light posts, and guardrails with pointed ends that spear cars. The savings to the public, in terms of prevented deaths, injuries, and property damage, will exceed this federal outlay many times over.

In the *postcrash* phase, an Institute crash test program identified a pattern of poor design in automobile fuel tank systems—so poor that even in medium-speed rear end impacts far below expressway travel speeds, such systems were routinely rupturing and losing large amounts of gasoline during and after the test crashes. The resulting risk of postcrash fire and the needless incineration of people in such cars prompted the Congress, after holding hearings to review the Institute's crash test results, to pass a law directing the U.S. Department of Transportation to set a rear-impact fuel system integrity requirement for new cars sold in the United States. The requirement took effect starting with 1977 model cars.

These are just a few examples of human, vehicular, and environmental conditions that contribute to highway losses in the precrash, crash, and postcrash phases and thus are among the targets of Institute inquiry and countermeasure development. These and many more are described in detail in the following pages. Moreover, the Institute's research work is covered on a continuing basis in its fortnightly news journal, *Status Report*.

The Institute's work is made widely available to, and used by, the public, government agencies, insurers, the press, automobile manufacturers, medical workers, universities, and many others. Its principal resources are a staff of concerned, capable people, aided by other experts drawn by the Institute on a project-by-project basis from a range of relevant research disciplines and organizations. The end result is production and dissemination of knowledge—knowledge that is scientifically excellent; directly relevant to the nature, extent, and reduction of real-world highway losses; and useful in practical terms to private and public organizations whose policy and operating decisions can help determine whether and how needless human and economic waste on the highways will or will not be eliminated.

The Institute works to prevent human and economic harm. That is why it exists.

Programs

In research, demonstration, and communications projects carried out since its reorganization in 1969, the Institute has identified, defined, and analyzed a range of real-world highway loss problems and countermeasure alternatives. The following are some examples of this Institute's work.

(Additional details of the projects summarized below, as well as information concerning other Institute projects, are available in *Status Report*, the Institute's fortnightly news journal. *Status Report*, which covers both Institute work and other leading developments in the field, is available without charge. For information, write to Communications Department, Insurance Institute for Highway Safety, Watergate 600, Washington, D.C. 20037.)

ISSUE: TESTING FOR ALCOHOL AND OTHER DRUGS

Problem: How reliable are devices and procedures used by law-enforcement agencies to determine an individual's use of alcohol or drugs, and how can they be improved?

Institute Action:

☐ Eight types of widely used disposable devices for breath testing of blood alcohol concentrations were evaluated by Institute and North Dakota State University researchers in a joint research project. (These were simple devices using an alcohol-sensitive reagent, not to be confused with the more sophisticated testing instruments—such as the Breathalyzer and Photo-Electric Intoximeter—which use photo-electric analysis and other chemical and physical methods, and whose results correlate well with actual blood concentrations.) The evaluation showed that the disposable devices produced high numbers of erroneous results in practically all ranges of actual blood alcohol concentrations. The researchers cautioned that law-enforcement agencies using such devices should be aware particularly of the two types of erroneous results found: (1) false positive readings indicating that a blood alcohol concentration is above the legal limit when, in fact, it is below, and (2) false negative readings indicating that the blood alcohol concentration is below the legal limit when, in fact, it is above.

☐ Results of the breath-tester evaluation were applied by the Institute in an analysis of actual driver blood alcohol concentration data obtained from an earlier study in Grand Rapids, Mich. The analysis showed that if such inaccurate disposable devices were used by police to screen randomly selected drivers, excessively high numbers of false arrests could occur while, at the same time, dangerously impaired

drivers would be allowed to remain on the highway. The findings raised serious questions about the reliability of the disposable breath alcohol screening devices, and led to a marked decrease in the use of the disposable breath testers. The study also spurred intensive efforts by the Department of Transportation and several manufacturers to develop more accurate and reliable hand-held electronic breath alcohol testing instruments, and these now are available and in use.

☐ A simple procedure for diagnosing the presence and amount of alcohol in trauma patients was discovered by researchers supported by the Institute and the Maryland Medical-Legal Foundation. Serum osmolality tests, using what is called the freezing point depression method, were made on emergency room patients and were found to be quick, inexpensive, and highly accurate in estimating blood alcohol concentrations. The findings are important because the presence of alcohol, which is found to some degree in nearly one-half of emergency-room patients, can, in concentrations often present, seriously affect the accuracy of the diagnosis of serious injury and alter the response to treatment and anesthesia.

☐ Research on breath alcohol analysis by a scientist at the University of Oklahoma, supported in part by the Institute, refuted suggestions that alcohol in the mouth may affect the results of breath tests for drunk driving under recognized law-enforcement procedures. The study confirmed that the 15-minute waiting period under observation, commonly used by law-enforcement agencies before taking breath tests from drunk-driving suspects, is adequate to permit a reliable test without distortion of the results by alcohol in the mouth. It scientifically refuted opinions that alcohol in the mouth could affect test results for 20 minutes or more after the subject's exposure to alcohol, and that rinsing the mouth with water did not

make any difference. The research also showed that the highest consistent breath alcohol concentrations are measurable after two-thirds of the expired breath has been discarded, a point of importance in the design of the breath sampling methods used by breath testing devices.

☐ The same University of Oklahoma researcher also developed, with Institute support, a method of storing breath alcohol samples for an extended period. The development was significant because several court decisions, based on conflicting scientific evidence, have held that failure to preserve ampoules used in chemical tests for breath alcohol were grounds for excluding the results of the test as evidence in a criminal prosecution. In the past, the necessary breath storage had not been feasible because of loss of alcohol from samples stored by the best methods then available. The problem was solved by development of calcium sulfate columns which showed no loss of alcohol after two weeks. Research is continuing on storage for longer periods.

☐ Analytical research supported by the Institute has resulted in a method that is suitable for routine use in the laboratory detection of tetrahydrocannabinol (THC), the psychoactive substance in marijuana. The new method uses a chemical compound that links to THC, producing a unique compound that can be detected by fluorescent means. The researchers described the method as readily "suitable for routine use of the detection of THC in blood, serum, or plasma." The method was found to be "specific," meaning that it gives a result specifically for THC and distinguishes THC from other drugs that may be present, such as morphine or barbiturates. The method is also sensitive, since it is able to detect THC in blood in concentration of less than one part in a billion.

Bibliography: 32, 36, 37, 38, 40, 186, 189, 207, 273

Status Report: Vol. 11, No. 5, March 19, 1976; Vol. 11, No. 2, Feb. 3, 1976; Vol. 10, No. 13, July 30, 1975; Vol. 6, No. 11, June 7, 1971

ISSUE: ALCOHOL AND VEHICLE CRASHES

Problem: How often is impairment by alcohol involved in fatal vehicle crashes?

Institute Action:

☐ An Institute-supported study of fatal crashes in Maryland involving tractor-trailers showed that one-third of the tractor-trailer drivers killed in the crashes were impaired by alcohol. This was the proportion found to have blood alcohol concentrations of 0.10 percent or more and was approximately the same as for drivers of other types of vehicles in the study.

Reports of the post mortem blood alcohol concentrations of the tractor-trailer drivers also were compared with police descriptions of the drivers. Three of the eight tractor-trailer drivers with post mortem blood alcohol concentrations of 0.10 percent or more were listed as "apparently normal" in the police reports. One driver with a blood alcohol concentration of 0.25 percent was described in the police report as "apparently asleep." The comparison emphasized the importance of not reaching conclusions about the condition of drivers unless the assessment is based on chemical tests.

☐ Supported by the Institute and the Maryland Medical-Legal Foundation, researchers studied blood alcohol concentrations in fatally injured motorcycle riders. Their conclusion that "impairment by alcohol

may well be the most important human factor contributing to fatal motorcycle crashes" was based on an examination of the post mortem records of 103 individuals who died in 99 motorcycle crashes during a 2½-year period in Maryland. They suggested that the causal role of alcohol in motorcycle fatalities is indicated by the association they uncovered between the presence and amount of alcohol and the degree to which the motorcyclists appeared to be responsible for causing the crashes in which they were killed. The research also emphasized the need for chemical testing "of all drivers (including surviving drivers) as soon as possible following all fatal crashes."

Bibliography: 19, 23

Status Report: Vol. 12, No. 9, May 31, 1977; Vol. 11, No. 2, Feb. 3, 1976

ISSUE: DRUGS AND DRIVING

Problem: To what extent do alcohol and other drugs, taken separately or in combination, affect an individual's ability to drive?

Institute Action:

☐ A continuing series of studies of drugs is being sponsored by the Institute at the Southern California Research Institute. Preliminary reports from two of the studies indicate that even moderate doses of two common drugs—a tranquilizer and an antihistamine—impair driving skills and, when taken in combination with moderate doses of alcohol, produce even greater impairment. The tranquilizer is diazepam (sold under the trade name of Valium) and the antihistamine is diphenhydramine hydrochloride (sold under the trade name Benadryl).

Test subjects were given various combinations of each drug, alcoholic beverages, and placebos under controlled laboratory conditions. They then were subjected to a battery of behavioral tests including a tracking task, a tracking task and visual search task performed simultaneously, a test of information processing rate, and an examination of eye movements while performing the visual search task. The aspects of behavior studied by the tests are known to be important elements in the driving task, and impairment of these skills is believed to be related to crashes.

Bibliography: 183, 184

Status Report: Vol. 12, No. 17, Nov. 30, 1977

Pre-crash

ISSUE: EFFECT OF LOWERED DRINKING AGES

Problem: In the early 1970s, about half the states reduced their minimum legal age for drinking alcoholic beverages, in most cases to 18 from 21. The effect of such action on highway death and injury, although the subject of much speculation, had not been scientifically researched.

Institute Action:

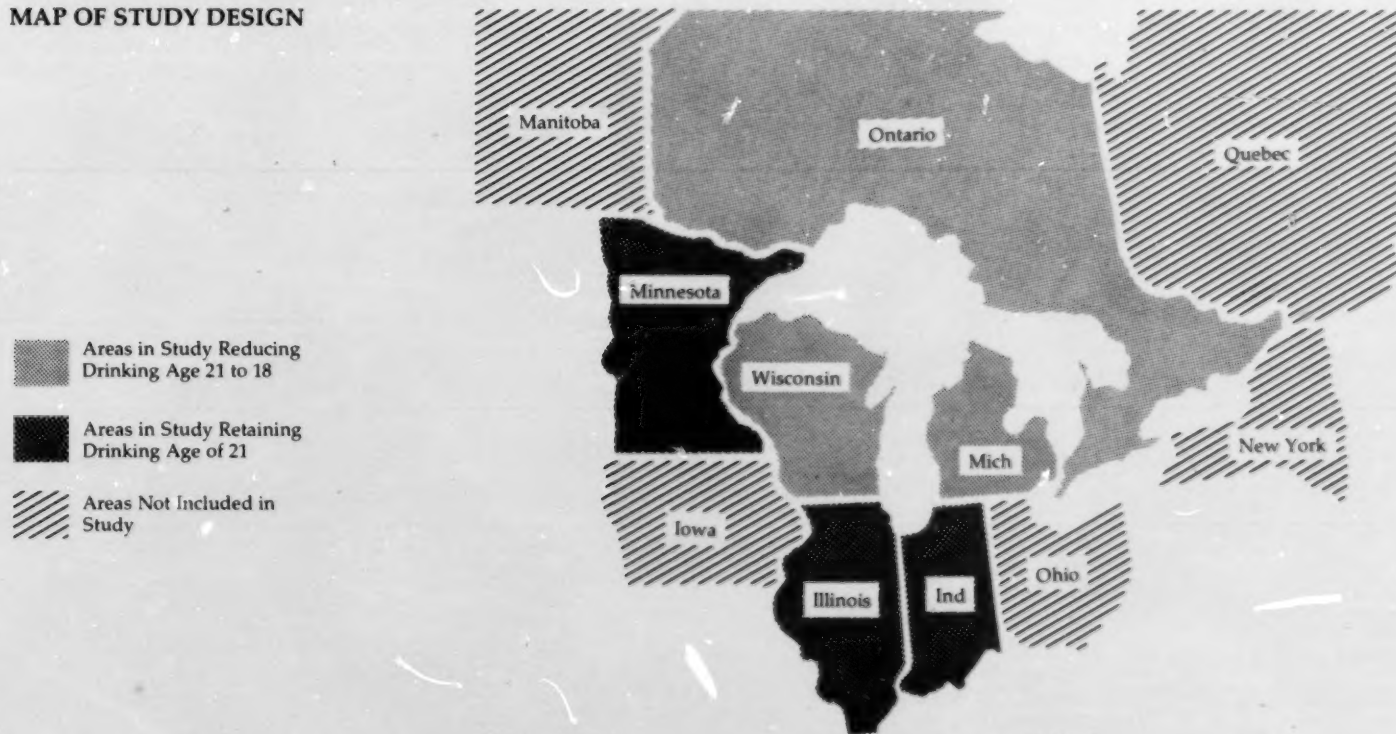
□ The institute conducted a study to compare fatal crash involvement levels for drivers under 21 years old in a number of Midwestern states and a Canadian province that had recently lowered the legal drinking age to 18, with those in adjacent states in which the

legal drinking age remained at 21. They found that in the "lower drinking age" states in the first year after reduction of the drinking age from 21 to 18, there was approximately a 5 percent increase in the number of 15- to 20-year-old drivers involved in fatal crashes.

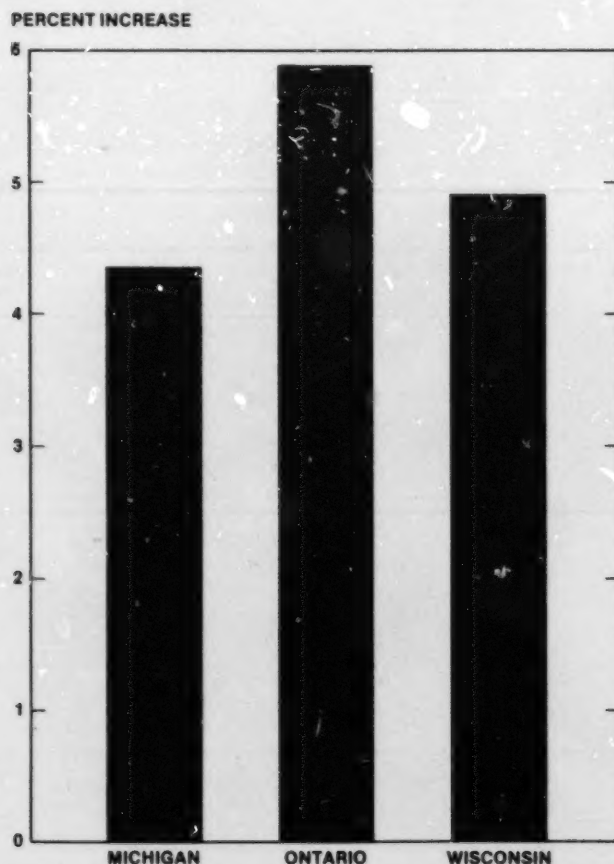
Noting a "significant increase of involvement in fatal crashes of drivers under 21 in areas that changed the law, particularly in nighttime and single-vehicle crashes where alcohol is most often involved," the study concluded that reducing the legal drinking age represents a "social policy that carries a price in increased fatal motor vehicle collisions."

Subsequently the legislatures of many states and provinces have considered the possibility of again raising the legal drinking age. Starting in 1976, several

MAP OF STUDY DESIGN



Increases in fatal crash involvement of 15-20 year old drivers after reduction of the minimum drinking age from 21 to 18



states and one Canadian province that had previously lowered the drinking age raised the age again, although not necessarily back to the age specified before the previous action.

Bibliography: 283

Status Report: Vol. 9, No. 7, April 9, 1974

ISSUE: PROBING THE 'SCANDINAVIAN MYTH'

Problem: For over 30 years, the Scandinavian countries have had some of the world's strictest drinking and driving laws. Some call for automatic imprisonment and loss of driver's license. Do the laws work?

Institute Action:

11

☐ A study carried out for the Institute by a researcher from the University of Denver showed that the deterrent effect of such strict laws is not supported by evidence. Before-and-after data were analyzed to determine the effectiveness of these laws. No significant changes in the number or rate of fatal motor vehicle crashes were found to be associated with the laws. The study concluded that at present, several thousand people annually "waste their time in jail in honor of a plausible but fundamentally unsupported hypothesis."

Bibliography: 238

Status Report: Vol. 10, No. 9, April 28, 1975

ISSUE: ALCOHOL SAFETY ACTION PROGRAMS

Problem: The National Highway Traffic Safety Administration sponsored a number of local Alcohol Safety Action Programs (ASAP). Each of the initial 35 programs cost an average of \$2 million. The programs, carried out in communities, combined intensified enforcement of drunk driving laws with special campaigns for identifying and rehabilitating problem drinkers who drive. NHTSA claimed, for eight of the ASAP programs it evaluated, that "a small but significant reduction in fatalities has occurred which can be attributed to ASAP's at those eight projects for two full years of operation. . . ."

Institute Action:

☐ The Institute examined in detail the effectiveness of those eight programs and 20 more ASAP's, by comparing year-to-year variations in highway crash fatality patterns in the ASAP locations with those in closely comparable non-ASAP locations, both before and during the ASAP's operational periods. When compared to the non-ASAP locations, "the year-to-year fluctuations in the proportions of ASAP area fatalities reveal no systematic reduction in these proportions" during the years that ASAP was in effect, the work found. In addition, the Institute study said that NHTSA erroneously concluded that the eight ASAP's it analyzed were effective because the agency's measurement found "a significant change . . . in the relation between day/time and nighttime fatal crashes that followed the introduction of ASAP's." Actually, the Institute pointed out, the "decrease in the proportion of nighttime fatal crashes was equally present both in the ASAP and in the comparison areas. It is, therefore, not justified to conclude that ASAP's were responsible for the changed relationship between nighttime and daytime fatal crashes. . . ."

Bibliography: 297

Status Report: Vol. 9, No. 13, July 8, 1974

ISSUE: EVALUATING A DRUNK DRIVING CRACKDOWN

Problem: During 1970 and 1971, Chicago traffic courts instituted a policy of seven-day jail sentences for drunk drivers. The program was proclaimed a success because during this period there was a reduction in fatalities.

Institute Action:

☐ An Institute staff member and researchers from the University of Chicago and the University of Denver developed a joint study of this judicial policy. It found that no effect from the crackdown had been or could be proved. The reduction in fatalities was well within the bounds of chance variation. Statistically, the same reductions could have occurred without the threat of jail sentences; in a comparison city, Milwaukee, the researchers found a similar reduction during the same period even though the city had no "crackdown."

The researchers pointed out the dangers of conducting programs without careful analysis. "If we are to reduce the tragic losses incurred from drivers impaired by drinking, it is necessary that various countermeasures be tried and evaluated as to effectiveness. However, if we are not judicious in careful analysis of assumptions and the evidence on which they are based, we shall continue to mount campaigns which are costly in money, time, and effort and which preclude development and applications of effective ones."

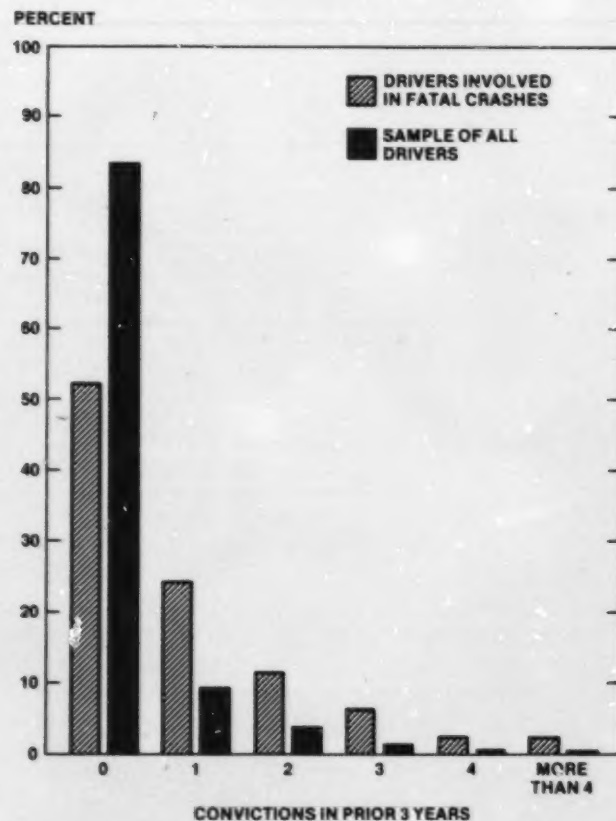
Bibliography: 214

Status Report: Vol. 7, No. 10, May 22, 1972

ISSUE: HABITUAL OFFENDER LAWS

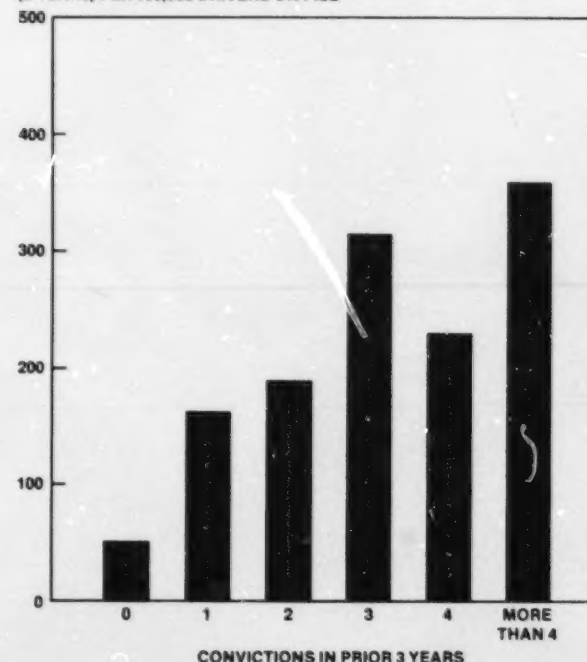
Problem: Since 1969, many states have passed laws aimed at keeping habitual traffic law violators off the road by license suspension, revocation, and, in some circumstances, jail sentences. Do the laws work and, if they do, how effective are they?

Prior convictions of drivers in fatal crashes compared with all Maryland drivers



Prior violation records of 1447 drivers involved in fatal crashes

FATAL CRASH INVOLVEMENT
(2 YEARS) PER 100,000 DRIVERS ON FILE



Institute Action:

□ Researchers from the Institute and Johns Hopkins University applied the criteria of Virginia's habitual offender law to records of Maryland drivers involved in fatal crashes. Maryland has no such law. The study found that only 22 of the 1,447 drivers would have been classified as "habitual offenders," and therefore subject to habitual offender sanctions. The majority of the drivers were found to have had no convictions for violations in the preceding three years.

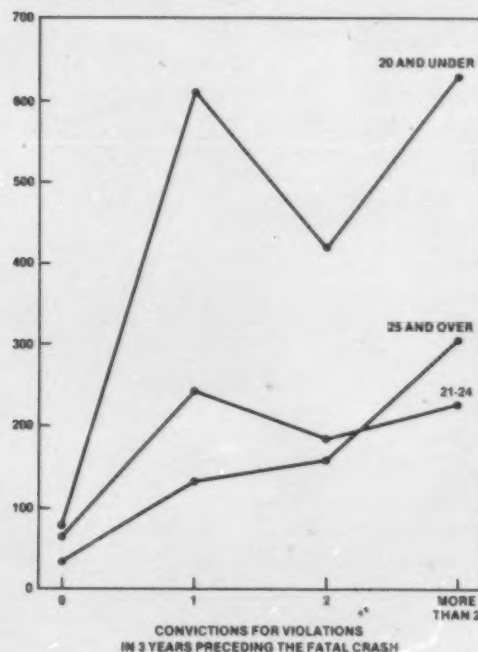
It is not possible, the researchers cautioned, to identify a small group in the population that accounts for even

Precrash

a modest, let alone substantial, proportion of all serious crashes. However, they added, "when the available precrash records of violations and descriptives of many individuals are aggregated, the results are related to involvement in fatal motor vehicle crashes. Thus, certain combinations of violations and descriptives can be used to identify groups of drivers more likely to be involved in such crashes than other groups."

In this respect, persons 20 years old and under were found to have by far the worst relationship between convictions for violations in the preceding three years and fatal crash involvement. Moreover, among persons of all ages, fatal crash involvement jumped sharply with only one conviction in the prior three

Fatal crash involvement
per 100,000 drivers in 2 year period



years, a finding of considerable importance from the standpoint of the choice of the number of prior convictions that should serve as the basis of licensing and other administrative actions.

Bibliography: 217

Status Report: Vol. 9, No. 19, Oct. 29, 1974

ISSUE: IS LICENSE LOSS A HARDSHIP?

Problem: A widely held assumption, which is believed to substantially influence license suspension and revocation decisions by some courts, is that loss of a driver's license produces economic hardship by denying the license holder transportation to and from work.

Institute Action:

☐ Researchers from Johns Hopkins University and the Institute staff examined this assumption and found that:

Only 21 percent of those interviewed said they would be unable to make alternative travel arrangements if prevented from driving.

Two-thirds said the alternative would cost no more than driving themselves.

Fewer than 20 percent said that the time required for alternative travel would be more than an additional half hour per day.

The researchers concluded that policies and procedures governing driver license suspension and revocation should not be based on the assumption that loss of license will result in economic hardship.

Bibliography: 17

Status Report: Vol. 9, No. 18, Oct. 11, 1974

ISSUE: 'MASTER LICENSE' PROPOSAL EXAMINED

Problem: The National Highway Traffic Safety Administration proposed in 1972 that a "Master Driver License" program be initiated to reward drivers who took crash avoidance and other "high performance" training with such "privileges" as "a reduction on their annual insurance premium" and "reduced rates on tollways." The proposal was based on the widely held assumption that drivers who have received such training are less likely to be in crashes than other drivers.

Institute Action:

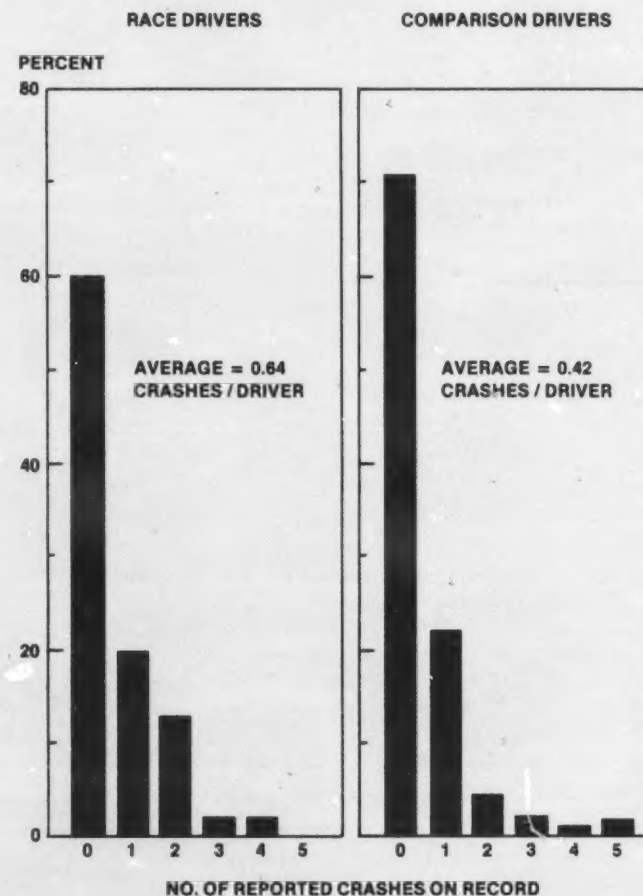
□ Staff researchers, working with records from three large states, compared the off-track highway driving records of a group of "national competition license" holding race drivers—those certified by the Sports Car Club of America as having completed advanced education and training in emergency driving techniques—with records of run-of-the-mill drivers. The study showed that "in each state the race drivers had higher average numbers of crashes and violations in every category analyzed than the matched (control group) drivers." For example, the average number of reported highway crashes per driver was higher for the race drivers than for compared drivers—0.28 compared with 0.14 in Florida, 0.64 compared with 0.42 in New York, and 0.58 compared with 0.49 in Texas. This relatively worse experience was still found to be so when mileage driven by members of each group was taken into account. The results, the researchers concluded, "suggest a need for caution regarding the assumption that advanced driver education, crash avoidance, and related techniques can be translated into reduced crash experience."

NHTSA has taken no further action regarding its proposed "Master Driver License" plan.

Bibliography: 282

Status Report: Vol. 9, No. 5, March 5, 1974; Vol. 8, No. 18, Oct. 5, 1973

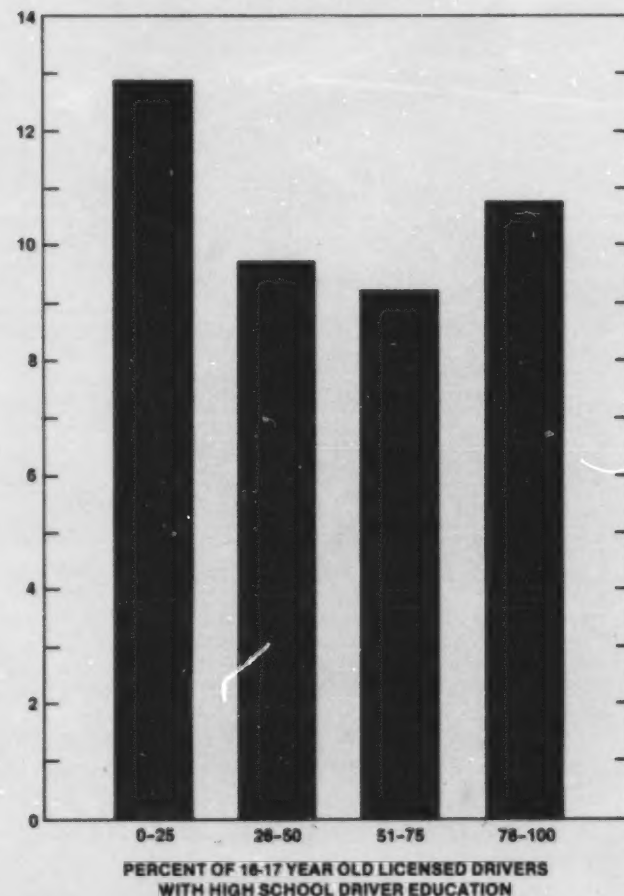
Distributions of the number of reported crashes per driver—New York



ISSUE: HIGH SCHOOL DRIVER EDUCATION

Problem: High school driver education is one of the most traditional and widespread means employed to introduce young people to driving, and to attempt to

Average fatal crash involvement
per 10,000 16-17 year olds licensed



reduce the disproportionately large amounts of human and economic damage they generate in their operation of vehicles. Yet, as stated by a select committee on highway safety of the Ontario parliament in 1977, "... all careful studies have shown that it is, at best, of questionable value in reducing accidents and fatalities. It seems that new drivers with similar backgrounds have much the same driving records whether they take driver training or not."

During the previous decade a number of senior federal agency groups in the United States had independently reported similar conclusions. In addition, a recent large-scale British study found "... driver education had increased the number of drivers over and above what might normally be expected. After 5 years, this difference was no longer apparent, i.e., the course accelerated the decision to learn to drive in the short term." With respect to crash involvement, the British study said, "It should be borne in mind that we have, as yet, no evidence at all that driver education has been successful in reducing the accident rate per mile."

The Institute was very concerned that, if driver education in the United States was also prematurely increasing the number of young drivers, it might as a result be increasing the overall numbers of serious crashes in which young people as a whole are involved.

Institute Action:

□ Using extensive statistical analyses, the Institute examined relationships among high school driver education, licensure, and fatal crash involvement per licensed driver and per capita among teenagers, using data from 27 states. The research found, *first*, that the average per capita fatal crash involvement of licensed 16- and 17-year-olds was not related to the percentages of such license holders who had had high school

driver education (see first figure). Similar results were found for the 18- and 19-year-olds.

Second, the research also found, both in states requiring driver education for 16- and 17-year-olds to be licensed and in states not so requiring, that the greater the percentages of teenagers who received high school driver education, the higher were the percentages of their 16- and 17-year-old *populations* who were licensed. The corresponding analysis for 18- and 19-year-olds found only a small increase in licensure, indicating that the availability of driver education was not substantially increasing the numbers of this age group licensed.

Third, the work found that the combination of increased percentages of the 16- and 17-year-old *populations* being licensed together with no decrease after taking such education in the fatal crash involvement per license holder resulted in many more deaths in and involving this age group than would have otherwise occurred (see second figure).

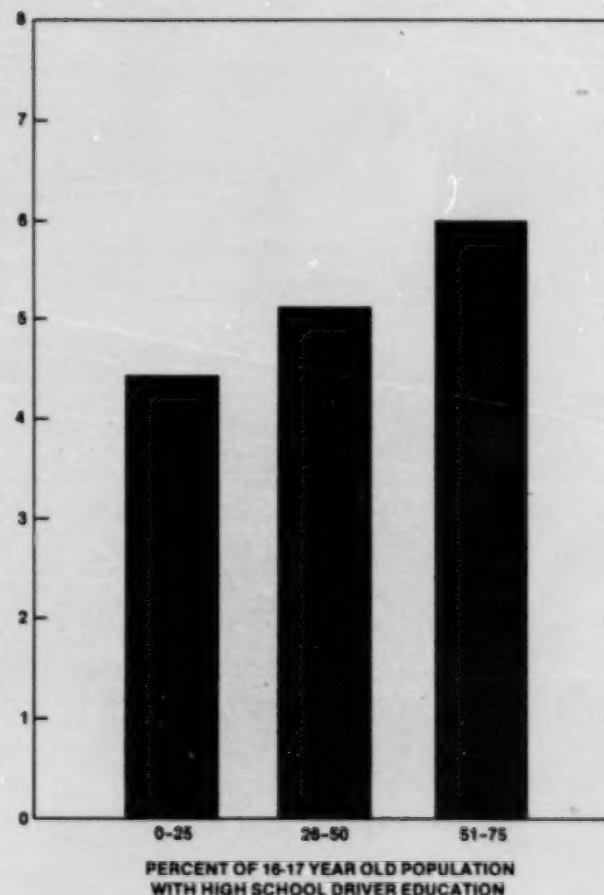
The research in *no way* dealt with whether high school driver education courses did or did not reduce the frequency or severity of involvement by 16-17-year-olds in non-fatal crashes, including crashes in which only property damage is sustained. The study dealt only with involvement by this age group, as drivers, in fatal crashes.

Following release of the Institute study, the National Highway Traffic Safety Administration, in a letter to the National Highway Safety Advisory Committee, noted: "The important element of the IIHS study is that it recognizes the relationship between driver education and the licensing of young people—a relationship that deserves attention. This adds a critical dimension to approaches for evaluating the effectiveness of driver education."

Bibliography: 237

Status Reports: Vol. 13, No. 3, March 2, 1978; Vol. 13, No. 1, Jan. 16, 1978; Vol. 12, No. 17, Nov. 30, 1977

Fatal crash involvement of 16-17 year old drivers per 10,000 16-17 year old population

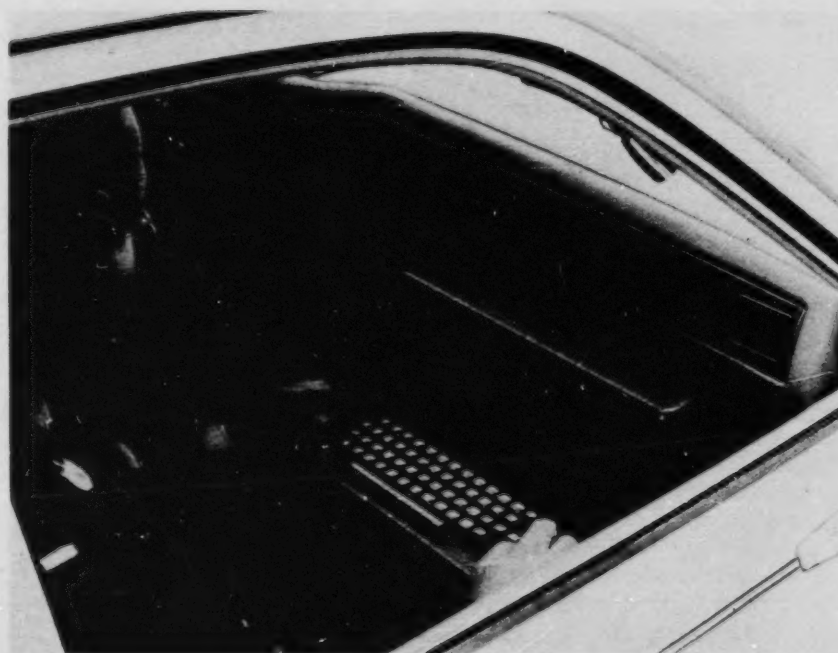


17

ISSUE: 'TAGS'

Problem: Patrolling the highways, police have had no practical means for mass-screening of motor vehicles in the stream of traffic to determine which vehicles may be stolen, driven by an individual with a suspended or revoked license or an outstanding criminal warrant, or are otherwise in need of further investigation. Unless the vehicle is being driven aberrantly, it is unlikely to come to the attention of the police. As a result, highway patrol time is less productive than possible, and vehicles that should be further investigated are not.

18



Institute Action:

☐ In cooperation with the Maryland State Police and the Maryland Motor Vehicle Administration, the Institute developed a project, known as TAGS, to demonstrate and test the practicality of mass screening of license plates in the traffic stream. In this work, specially outfitted state police patrol cars cruise the state's highways. An operator in the patrol car notes the license plate numbers of passing vehicles and types them into a small, on-board computer. The computer immediately compares each plate number against a current list of plates of vehicles (1) stolen, (2) associated with drivers with suspended or revoked licenses or outstanding criminal warrants, or (3) that failed state vehicle safety inspection. If a compared plate number agrees with one in the computer file, the police officer operating the patrol car takes follow-up action. Although still experimental, this type of approach holds considerable potential for assisting police in identifying and apprehending vehicles and owners involved in unlawful activity.

Bibliography: 177, 181

Status Report: Vol. 9, No. 13, July 8, 1974

ISSUE: ENFORCEMENT CRACKDOWN PROGRAMS

Problem: The National Highway Traffic Safety Administration conducted an experimental "Fatal Crash Reduction Program" in 1972 to determine whether intensified police patrolling and traffic law enforcement could reduce highway crashes and deaths. NHTSA asserted that in the Michigan counties used, the program did produce such reductions. On that basis, it launched a \$10 million, nationwide program to promote intensified enforcement of traffic laws—the "Fatal Accident Reduction Enforcement Program (FARE)."

Institute Action:

☐ Analyses by the Institute found that NHTSA used inappropriate designs and evaluative techniques to measure the results of the Michigan experimental program. To properly evaluate the program, the Institute compared Michigan crash and fatality trends in the experimental areas with those in areas not subjected to the federal program, and found no significant differences between highway crash and death rates in Michigan and the compared areas.

Bibliography: 284

Status Report: Vol. 9, No. 10, May 15, 1974

ISSUE: VEHICLE DESIGN DEFECTS

Problem: Analysis of reports to the Institute and discoveries in the course of Institute crash-testing programs have revealed safety-related defects in several vehicle models.

Institute Action:

☐ The National Association of Independent Insurers reported to the Institute that two insurance company officials had experienced sudden loss of steering control while driving two General Motors cars. An Institute-sponsored analysis of similar General Motors steering systems revealed that a design defect permitted small stones to become lodged in the mechanism, thus "locking up" the assembly. The Institute gave the findings to the National Highway Traffic Safety Administration and requested a full investigation. As a result, 3.7 million 1971 and 1972 General Motors cars with that design defect were recalled for installation of a protective shield around the steering assembly.

☐ Fuel line leaks in the engine compartment of a new 1975 Volkswagen were noticed during preparation for an Institute crash test. Both NHTSA and Volkswagen were notified, and after the manufacturer's representative inspected the vehicle all affected Volkswagens were recalled (in an extension of an earlier, limited recall program) for replacement of improperly installed fuel line clamps.

☐ During the preparation routine of two new 1978 Plymouth Horizons for Institute low-speed crash testing, leaks were discovered from the top of the cars' fuel tanks. The Institute informed NHTSA of this hazardous condition and worked with the agency the next day to pin down the cause: staples used to secure the back seat floor carpeting had been driven into the fuel tank immediately below. The manufacturer immediately recalled the 3,000 affected cars.

Bibliography: 130

Status Report: Vol. 13, No. 2, Feb. 7, 1978; Vol. 8, No. 4, Feb. 12, 1973; Vol. 7, No. 5, March 13, 1972

ISSUE: OCCUPANT RESTRAINTS

Problem: Thousands of motorists are killed or maimed each year because motor vehicles are not equipped with the most effective occupant restraint systems available, and because the majority of the public has neglected to use the nonautomatic protection now offered.

Institute Action:

☐ In more than eight years of research and analysis, the Institute has concerned itself extensively with the occupant restraint issue. Intensive Institute study has underlined the necessity for providing a maximum degree of automatic ("passive") protection—employing restraint systems that do not require specific individual action to be effective—in contrast to "active" systems such as nonautomatic safety belts, which the user must always remember to fasten. Finally, on June 30, 1977, after eight years of consideration, the government ordered that passive restraint systems be provided in new cars, starting with some models in the 1982 model year, to substantially reduce the injurious forces to which front-seat occupants otherwise are exposed in frontal crashes. Among the Institute actions that contributed to the shaping of this new policy were the following:

☐ Whether belt use can be encouraged by intensive television advertising was the focus of a major, long-term study. The Institute sponsored and evaluated a nine-month saturation campaign using television commercials urging safety belt use. A community cable television system was the medium, and professionally produced, award-winning advertisements urging belt use were shown to 6,400 households. Programming without the safety belt messages was shown to a control group of 7,400 homes. Drivers from both groups were observed before, during, and

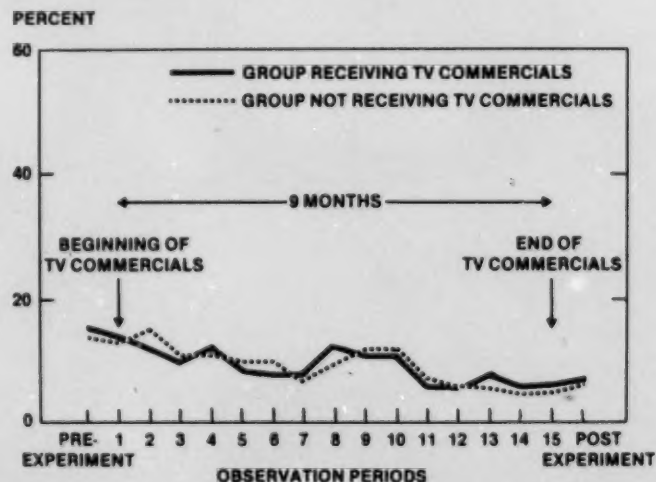
after the campaign. It was found that the advertising program had absolutely no effect on safety belt use.

☐ The effect of mandatory belt use laws was studied. Supported by the Institute, two Australian researchers compared the experience of the state of Victoria, which passed the first Australian mandatory safety belt use law in 1970, to the rest of Australia before the other states had passed such laws. They found that the law resulted in a 21 percent decrease in vehicle occupant fatalities in metropolitan areas and a 10 percent decrease in nonmetropolitan areas. The corresponding decreases in injuries were 13 and 11 percent.

☐ Buzzer-light reminder systems to encourage drivers to use their seat belts were studied to determine their effectiveness. Comparing belt use in cars equipped with these systems to that in unequipped cars in the same model year, no significant difference

20

**Seat belt use in group shown
television commercials and comparison group**



was found. The Institute concluded that the buzzer-light system was "a public health failure."

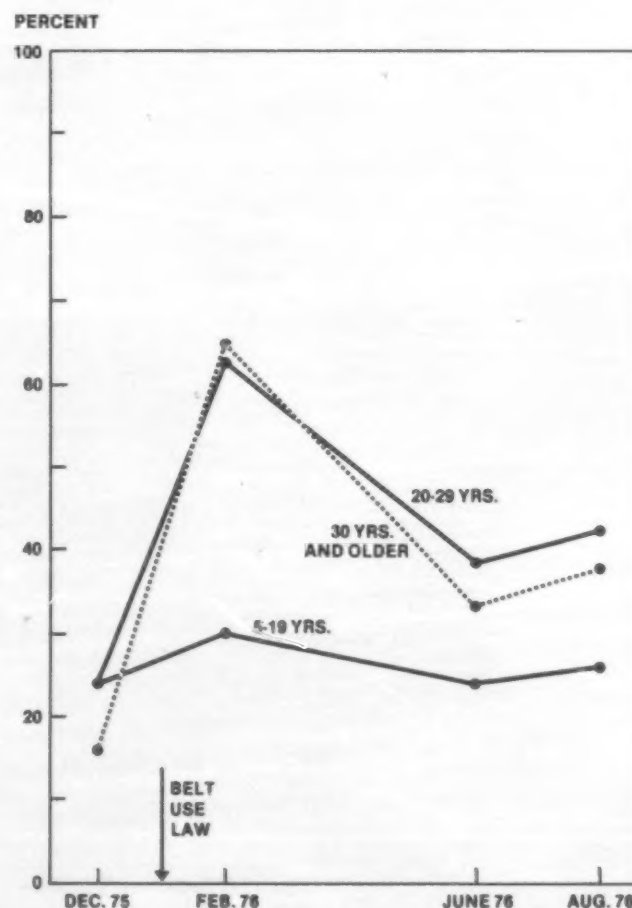
□ Starter-interlock system belt use was compared with belt use in cars equipped with buzzer-light warning systems. Observed use of belts increased significantly, but even initially 40 percent of the drivers still found a way to circumvent the interlock systems and avoid using belts. Institute researchers also conducted interviews to discover factors associated with belt use and with attitudes toward the interlock systems. They found that 29 percent of those interviewed labeled interlocks the least-liked feature of their new cars. Follow-up studies showed a decline of safety belt use to pre-interlock levels in the model-year cars equipped with starter-interlock systems. The interlock requirement later was eliminated by the Department of Transportation at the direction of the Congress.

□ Safety belt use has been found to be consistently low in surveys conducted by Institute researchers. Observations made early in 1976 in Baltimore, Detroit, Houston, and Los Angeles revealed that almost two-thirds of the drivers of 1976 model cars were not using either lap or shoulder belts and three-fourths of them were not using shoulder belts. Similar usage was found in drivers of 1974-75 model cars, while in earlier models more than three-fourths of the drivers were using no belts.

□ In a series of Institute tests, production cars of varying sizes (with and without air bags) were crashed into a concrete barrier. The anthropomorphic test dummies used in the cars to simulate vehicle occupants were unbelted, as are most vehicle occupants. The filmed tests dramatically demonstrated the way in which air bags respond to crash forces and inflate to gently cushion and decelerate the vehicle's occupants. A film incorporating some of the test results, *Crashes That Need Not Kill*, has been seen by more than 50 million viewers.

□ The results of Ontario's mandatory belt use law were studied by Institute researchers, who found that some of the law's early effects quickly eroded. Belt use by Ontario drivers was observed to increase from 23 percent in December 1975 to 75 percent in February 1976, the second month in which the new law was in

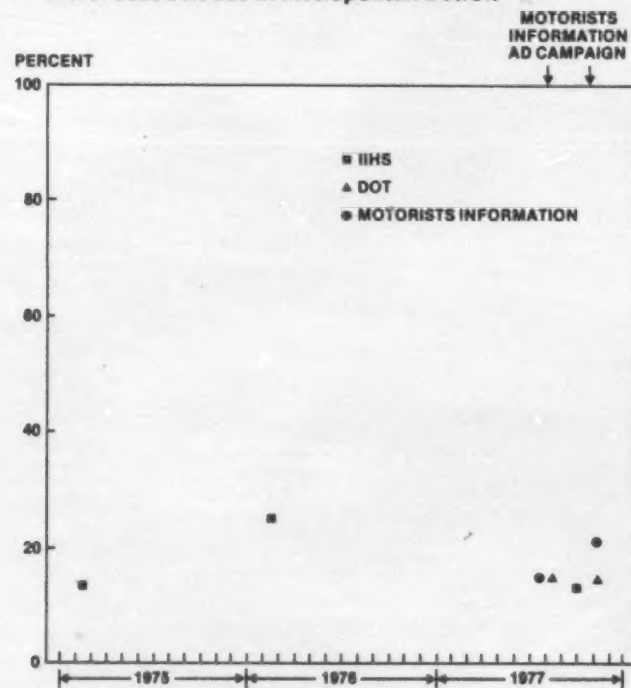
Driver and right front passenger shoulder belt use before and after belt use law in Ontario, Canada



effect. But by June usage had declined dramatically and the study found only 51 percent of drivers were using lap belts, and only 36 percent of drivers and right front seat passengers were using shoulder belts—down from 65 percent in February. Among teen-aged drivers, who are disproportionately involved in severe crashes, the study reported that the law had little effect—three-fourths of persons estimated to be less than 20 years old were not using shoulder belts six months after the law went into effect.

□ A nationwide public-opinion survey, sponsored by the Institute in July 1976, indicated that a large majority of car-buying Americans favored increased crash protection that is completely or at least partly automatic. The survey was based on interviews with 1,017 persons who said they intended to buy new cars

Driver seat belt use in metropolitan Detroit



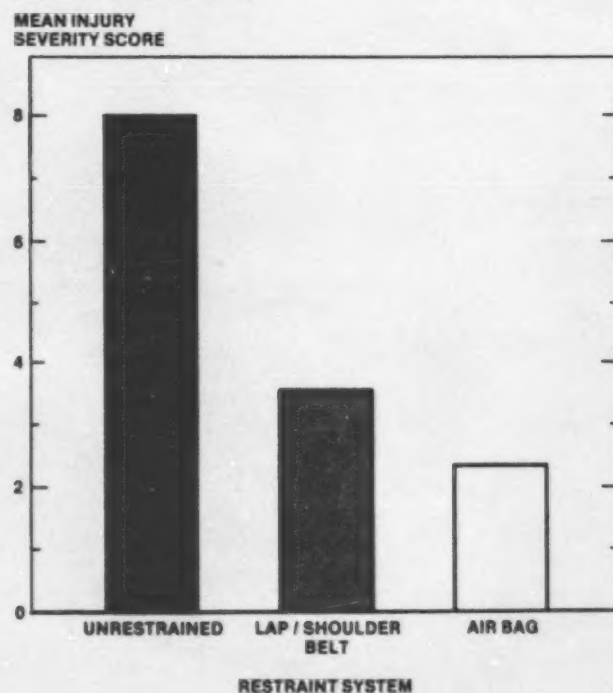
within three years. Of those interviewed, 77 percent said they preferred automatic protection—39 percent exclusively and 38 percent in combination with active restraints—and only 15 percent opted for active protection systems. The interviewees indicated they would be willing to add an average \$12 a month to their car payments for increased crash protection that would save 6,000 lives a year, \$17 a month for protection that would save 12,000 lives a year, and \$20 a month for systems that could save 18,000 lives a year. Half of those interviewed opposed mandatory safety belt laws and 47 percent favored such laws.

□ Passive-belt effectiveness was indicated in a report prepared by the Highway Loss Data Institute (see page 54) on comparative injury insurance claim frequencies between Volkswagen Rabbits sold with passive belts and the same models sold with active safety belts. Although the report stressed that the findings were preliminary because they were not based on great amounts of exposure, substantially lower injury claim frequencies were indicated for the cars having these automatic protection devices. Moreover, the data showed that the frequency of collision claims, as opposed to claims for injury, and the dollar magnitudes of the collision claims themselves were identical in the two groups, dispelling assertions that persons provided with automatic protection would crash more frequently or more violently.

□ Belt use promotional campaigns have little effect on public use of the active restraints, the Institute found in checking programs sponsored in Michigan cities by Motorists Information, an auto industry group. In Grand Rapids, only 13 percent belt use by drivers was observed after an intensive promotional campaign. Milwaukee, without any promotional campaign, was used as a comparison city, and researchers observed 12 percent belt use by drivers there. Subsequently, at the midpoint of a promotional campaign

in Detroit, similarly low belt use was observed there: 5 percent of drivers wearing only lap belts, 8 percent wearing lap and shoulder belts, and only 6 percent of the passengers wearing shoulder belts. Despite the promotional activity, the level of use of the active restraints in Detroit was actually lower than during a belt-use survey conducted by the Institute in the spring of 1976. The earlier survey revealed 11 percent lap and shoulder belt use and 14 percent use of lap belts only. The minimal effect of the promotional campaign was confirmed by the U.S. Department of Transportation, which found Detroit driver belt usage at 15 percent, unchanged between observational surveys before and after the campaign.

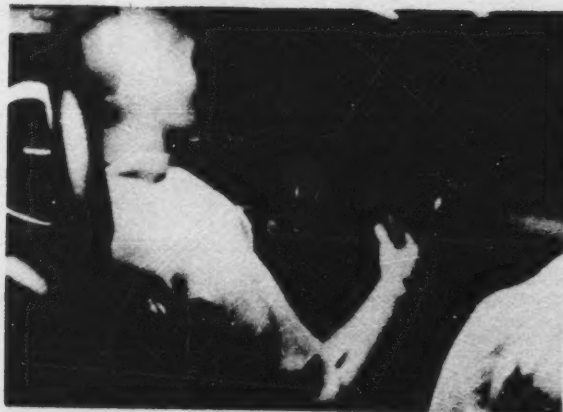
Mean injury severity scores for occupants in severe frontal crashes



□ Analysis by Institute researchers of three groups of real-world frontal crashes compared results of crashes in which front-seat occupants were using no restraints, those in which they were wearing lap/shoulder belts, and those in which they were automatically restrained by air bags. Both active lap/shoulder belts (when worn) and air bags were found to substantially reduce the severity of injuries to front-seat occupants of the full-size and luxury cars whose frontal crashes were the basis of the study. In the more serious frontal crashes the air bag protected occupants, 83 percent of whom were wearing *no* belts, experienced greater reductions in the average severity of injuries (64 percent) than occupants of such crashes wearing lap/shoulder belts (55 percent). The study also showed that as the severity of the crashes increased, the role of the restraints became more important.

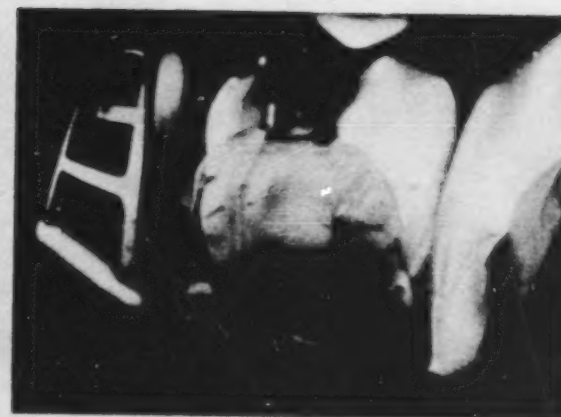
□ Institute analysis of data supplied by a major auto maker indicated major shortcomings in its analysis of its "matching case methodology" for evaluating effectiveness of air bag systems. The methodology matched crashes of all types and directions involving air bag-equipped cars with crashes of similar type and intensity involving cars equipped with active safety belts. By analyzing injuries in the crashes, the auto maker reported that a combination of air bags and lap belts was "only about 10 percent effective in reducing significant injuries." However, its analysis had failed to consider the effects of multiple injuries, a crucial omission because serious injuries to multiple regions of the body greatly increase the likelihood of death (see page 48). Consequently, Institute analysis considered multiple injuries resulting from the crashes, concentrating on head, neck, chest, abdominal, internal, and lower back injuries (the types of injuries most frequently resulting in death or serious impairment). On this basis the Institute found the frequency of

Crash



24

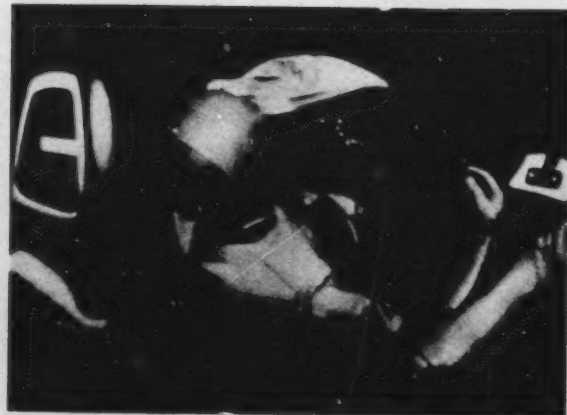
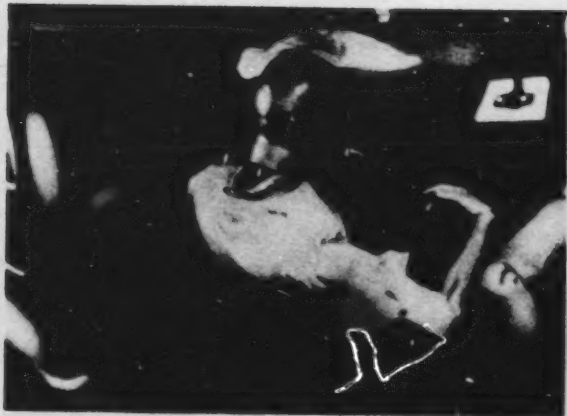
The Institute, as part of its research into passive restraint systems, impacted two 1975 Volvo sedans—one with an American-developed air bag system, one without—into a test barrier at 35 miles per hour. The sequence of photos above shows the unbelted test dummy in the driver position of the Volvo without air bags. Below is shown the dummy, also unbelted, being protected in the air bag-equipped Volvo. Each sequence covers about 0.25 seconds—a critical period of the crash in terms of occupant protection.



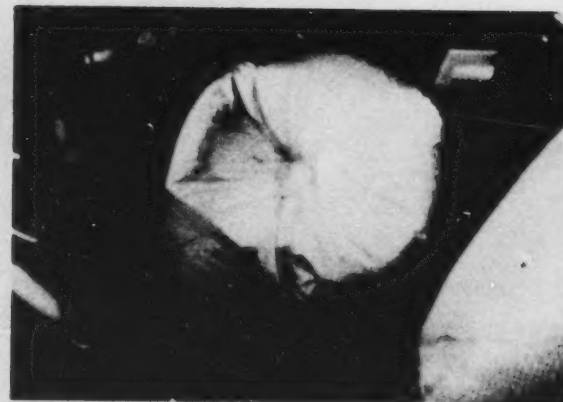
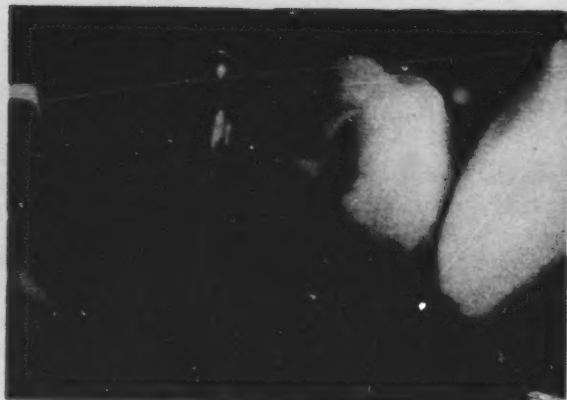
46

47

Crash



25



48

49

serious injury approximately 42 percent less for the occupants of the air bag equipped vehicles, a figure almost identical to the 40 percent fatality reduction estimated by the U.S. Department of Transportation.

□ Institute officials testified frequently, on invitation, during the course of the years-long debate over the proposed passive-restraint standard. At hearings held by the National Highway Traffic Safety Administration, Congressional committees, and two Transportation Secretaries, William T. Coleman and Brock Adams, the Institute cited laboratory tests and real-world experience with automatic restraints and supplemented its oral testimony with filmed documentation of air bag effectiveness. During these proceedings the public was kept informed of progress in the debate through regular stories in *Status Report* and through publication of the "Background Manual for Air Bags," a comprehensive reference work on occupant restraints that has been frequently updated since its first publication in the spring of 1975.

□ A study of vehicle occupant injuries matched with auto ownership records refuted arguments that a car's original purchaser should be free to select safety equipment for his vehicle on an optional basis, on the assumption that it is the purchaser whose protection is in question. The Institute analysis found that fewer than one-fourth of those injured in auto crashes were both owners and original purchasers of the vehicles in which they were injured. The ownership study, based on records of crashes during 1977 in Baltimore County, Maryland, found that of the injured about half were occupants of vehicles that were no longer owned by the original purchaser, 59 percent did not own the vehicles in which they were injured, 21 percent of the drivers and 74 percent of the passengers apparently were not related to the owner, and 30 percent were less than 21 years of age.

□ The Institute has also, on a continuing basis, obtained and analyzed the increasingly huge amount of real-world experience with air bag-equipped cars and has provided the results to a wide variety of interested individuals and organizations. By March 1978 this real-world experience had totalled well over a half billion miles of operation on U.S. and Canadian roads, with 185 reported crash deployments involving 267 front-seat occupants. The crashes included a very wide variety of violent, single and multiple impact collisions with both fixed objects such as poles and with other vehicles. Three in the Southwest even involved high speed impacts with large cattle. The front-seat occupants in the 185 crashes were of many ages—children, teenagers, adults, and the elderly. The injury reductions produced were highly favorable and entirely consistent with those reported earlier by the U.S. Department of Transportation and the Institute.

Bibliography: 24, 42, 76, 83, 86, 87, 135, 136, 137, 154, 158, 182, 195, 213, 215, 216, 220, 221, 224, 226, 228, 229, 231, 233

Status Report: Vol. 13, No. 5, April 12, 1978; Vol. 12, No. 16, Nov. 8, 1977; Vol. 12, No. 15, Oct. 13, 1977; Vol. 12, No. 14, Sept. 26, 1977; Vol. 12, No. 13, Aug. 15, 1977; Vol. 12, No. 12, July 26, 1977; Vol. 12, No. 10, June 16, 1977; Vol. 12, No. 7, May 9, 1977; Vol. 11, No. 19, Dec. 13, 1976; Vol. 11, No. 10, June 28, 1976; Vol. 11, No. 6, April 12, 1976; Vol. 11, No. 5, March 19, 1976; Vol. 10, No. 11, June 18, 1975; Vol. 9, No. 16, Sept. 9, 1974; Vol. 9, No. 13, July 8, 1974; Vol. 7, No. 11, June 12, 1972

ISSUE: NECK INJURIES

Problem: The very commonplace yet inadequately understood neck injuries sustained in automobile crashes are often called "whiplash." The term actually embraces a range of damage to the complex structures of the neck. Effective January 1969, a federal motor vehicle safety standard required that new cars be equipped with head restraints at each front out-board seating position to prevent or reduce such injuries. Are these devices effective? What are the properties of the human neck which may relate to a person's susceptibility to whiplash injuries? Such information, although not available, was necessary to upgrade seat and head restraint designs, and to improve the designs of anthropomorphic dummies used in crash testing.

Institute Action:

☐ The Institute, in conjunction with the State Farm Mutual Automobile Insurance Company, conducted a study based on nearly 7,000 two-car front-to-rear crashes. The study found that:

In the absence of head restraints almost one out of every three front-to-rear crashes resulted in a claimed neck or back injury for the driver of the forward car. With head restraints there was an overall 18 percent reduction in claimed whiplash injuries to drivers. For female drivers the reduction was 22 percent and for males there was a smaller percentage reduction of 10 percent.

Surveys of drivers in Los Angeles and Washington showed that 84 percent of male and 71 percent of female drivers had their adjustable head restraints improperly positioned where they were unable to provide the intended protection.

The surveyed crashes produced a higher incidence of claimed whiplash injuries among female drivers than among male drivers.

☐ Following this evaluation it was apparent that much additional basic knowledge concerning the properties of the human neck was needed to better understand the various physiological possibilities that might account for differences in susceptibility to whiplash. As a result, the Institute funded a study at the Highway Safety Research Institute of the University of Michigan on the basic biomechanical properties of the human neck related to whiplash injuries. This study has documented range of motion, muscle strength, muscle response, and other complex characteristics of the human neck, relating them to the sex, age, and stature of the subjects tested. These basic data and results have been used by other groups in the study of aircraft seat design, in the development of child automobile restraints, and also in the design of advanced anthropomorphic dummies to enable better simulation of the human neck in crash testing programs.

Bibliography: 25, 26, 44, 142, 187, 212, 241, 243, 272

Status Report: Vol. 10, No. 10, May 12, 1975; Vol. 6, No. 17, Sept. 20, 1971

27

ISSUE: CHILDREN IN CRASHES

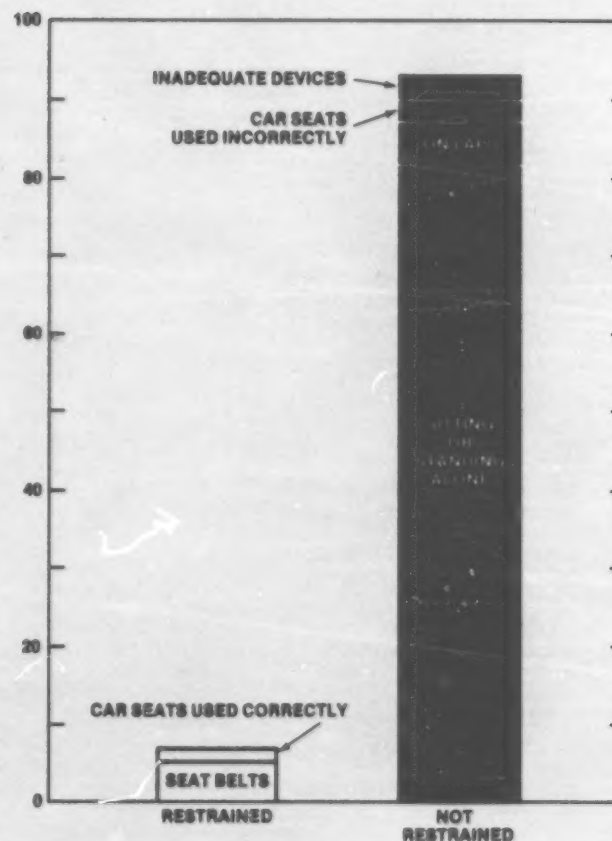
Problem: How are children in automobiles best protected from crash death and injury, and how frequently are they restrained by available active restraint systems?

Institute Action:

□ An Institute observational survey of 8,893 children younger than 10 years old who were passengers in automobiles revealed that only 7 per cent were properly restrained. The rest were improperly restrained or traveling without restraints. Of the latter group, 82 per cent were sitting or standing unrestrained, 6 per cent were on the lap of another person and unrestrained, 5 per cent were in child restraint devices that were not properly fastened down and/or in which the child was not restrained, and 1 percent were using inadequate protective devices (the percentages add to more than 100 because of rounding). It was observed that when adults in a car were not using their own seat belts, practically none of the children in the car were restrained. Even when drivers had taken the precaution to fasten their seat belts, more than 75 per cent of the child passengers were left without proper restraints. The survey involved observations of the occupants of 5,050 automobiles at 14 amusement areas and shopping centers in Maryland, Massachusetts, and Virginia.

□ Because of concerns raised by some during development of early air-bag systems that an unrestrained child, standing on a moving car's front seat floor or otherwise out of position, might not be protected by such automatic systems, or might be injured by the bags during the early stages of their deployment, the Institute studied the positions in which children actually travel in vehicles. Of the 4,602 child passengers

Observed restraint use of passengers less than ten years old in automobiles

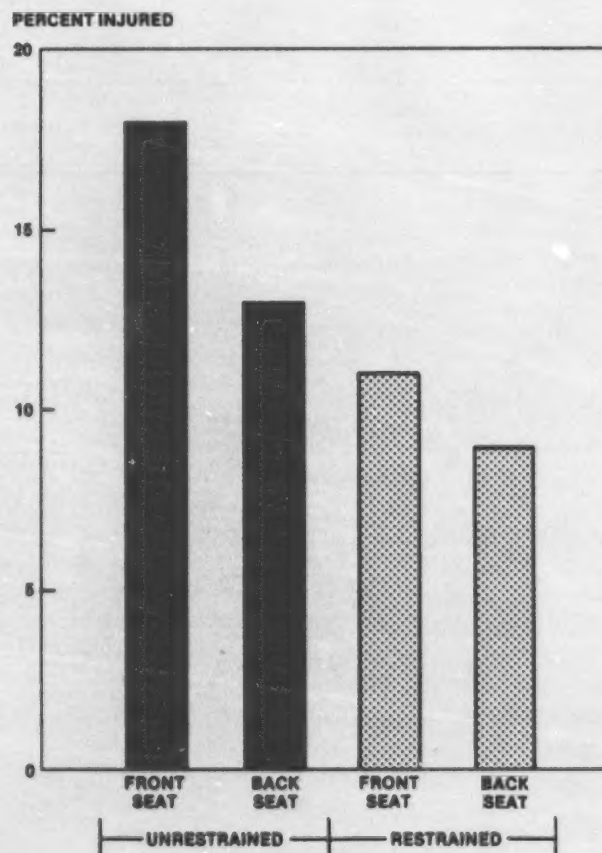


observed, only 7 were standing on the front seat floor. Additionally, 4 children were observed sitting or kneeling on the front seat floor, 2 kneeling on the front seat and leaning on the dashboard, 7 on persons' laps in the front seat with their arms or upper bodies in contact with the dashboard, and 103 sitting, standing, or kneeling on the front edge of the front seat of the vehicle whether or not in contact with the dashboard. Thus only 123 of the children—less than 3 per cent—were observed in types of front seat positions of special interest in which the child could be contacted by a first-generation air bag early in its deployment. Not a single one of these children was restrained by present active restraint systems. Consequently none were appropriately protected against crash injuries in the absence of air bags or other automatic restraints. The results of serious real-world crashes of cars equipped with air bags in which children were protected from death and injury, and subsequent refinements of air-bag technology, indicate that air bags can protect even the small percentages of children traveling in these abnormal positions.

□ The possible advantages and disadvantages of safety belts for children were analyzed in a research paper. It concluded that younger children and infants should use specially designed child or infant restraint systems as a first choice, but that where such child restraints are not available, lap belts should be worn. Lacking either of these systems and "until contrary evidence is available," the report recommended use of the three-point belts for small children as the third choice. Use of child seats that hook over the auto seat back was not recommended, and the report stressed that under "no circumstances should children and infants be unrestrained in a motor vehicle."

□ An Institute study showed that children are least likely to be injured in crashes if they are restrained and in the back seat, and are most likely to be injured

Injury rates of passengers less than 15 years of age
in crash-involved automobiles



if unrestrained and in the front seat. Data involving 26,971 passengers younger than 15 years old in reported crashes over a two-year period showed that less than 1 in 10 was restrained in some fashion. Back seat location reduced the injury rate by 28 per cent among unrestrained children and 18 per cent among restrained children. Use of active restraints—safety belts or child restraint systems—reduced the injury rate by 39 per cent in the front seat and 31 per cent in the back.

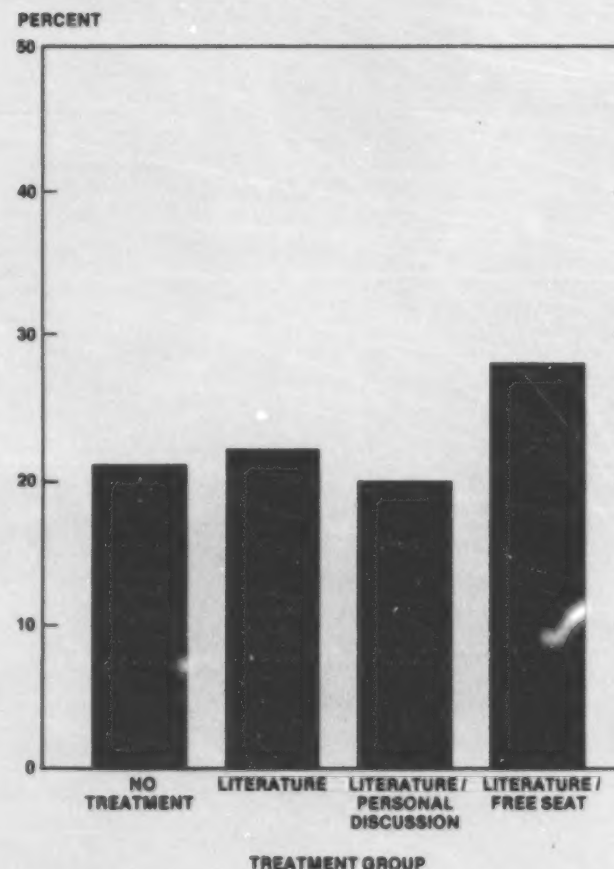
On the basis of these findings and in the absence of automatic restraints such as air bags, the study recommended that children should be restrained by a seat belt or a specially designed child restraint system and preferably should travel in the back seat. It particularly emphasized that children should not be positioned unrestrained in the right front seat.

□ Efforts to encourage new mothers to use restraint systems to protect their infants from crash injuries were the subject of another Institute study. It revealed that persuasive methods and inducements—even free infant restraints—failed to increase substantially the proper use of restraints. Specially devised in-hospital programs of education and persuasion resulted in a few more mothers using infant restraints in their cars, but had little effect in encouraging adequate fastening of the restraints with car seat belts—a prerequisite if such restraints are to protect children in crashes.

On discharge from the hospital there was a very slight increase in the use of infant restraints in each of the groups that received educational treatments, but restraint use was low and about 9 out of 10 infants in each group were held in someone's arms. The in-hospital instruction had emphasized the lack of crash protection this afforded the infant.

When the infants were two or four months old, infant restraint use was observed. Only 21 per cent of the

Observed use of infant carriers fastened by car seat belts at ages 2-4 months



total groups were using the restraints correctly. The group receiving literature on restraints had only 22 percent using restraints correctly, those receiving both literature and a personal discussion had 20 percent correct restraint use, and those getting both literature and a free infant restraint had 28 percent correct restraint use. The researchers considered the key outcome measure not merely use of the infant restraint but use of it securely fastened by the seat belts, and with the child belted in the restraint.

☐ In an Institute study of the hazards associated with children traveling in the laps of adults, it was pointed out that children held on laps by adult arms cannot be adequately restrained in crashes. The study reported that children are actually placed in further jeopardy because of the likelihood of their being crushed by the persons holding them. In a study of 53 cases in which children traveling on laps were injured, injuries due to probable or definite occupant-to-occupant contact were reported in 42 percent of the cases. The injuries to the children ranged from lacerations to fatal injuries resulting from crushing.

Bibliography: 210, 244, 286, 287, 288, 290

Status Report: Vol. 13, No. 5, April 12, 1978; Vol. 13, No. 2, Feb. 7, 1978; Vol. 12, No. 15, Oct. 13, 1977; Vol. 11, No. 8, May 19, 1976

ISSUE: VEHICLE DESIGN AND PEDESTRIAN INJURIES

Problem: What are the design characteristics of automobile front ends that contribute to the frequency and severity of pedestrian pelvic and leg injuries? Do some bumper heights and front end designs produce more pedestrian injuries than others?

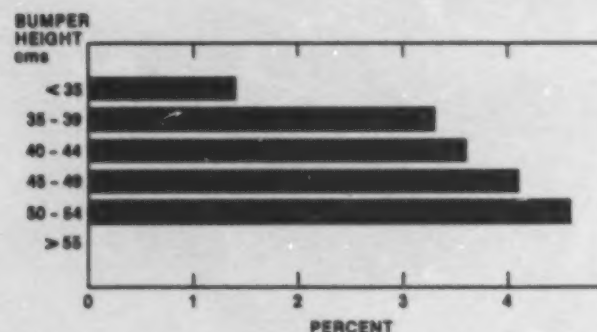
Institute Action:

☐ Since bumper and hood heights vary more widely on European than on American automobiles, the Institute sponsored a study of injuries sustained by pedestrians in Birmingham, England. Researchers from the University of Birmingham reviewed the case histories of 1,579 pedestrians who were hospitalized for injuries or killed by impacts by autos or light trucks over a five-year period.

The data show that leg injuries were the second most frequent type of non-minor injury suffered, with 90 percent of all leg and pelvic trauma being fractures. Virtually all of these injuries were caused by contact with the vehicle, with bumper contact causing 55

31

Non-minor knee injury by bumper height



percent and contact with the front structure above the bumper responsible for 42 percent.

It was shown that knee injuries were more likely to occur when the bumper height rose to one-quarter or one-third the relative height of the pedestrian. The researchers found that "vehicles with bumpers located at a height of 50 to 54 cm. (approximately 20 to 21 inches) had the highest incidence of knee injury."

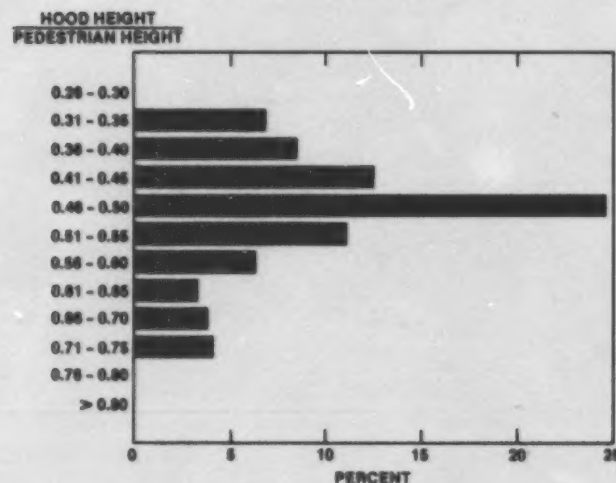
Pelvic injuries were more likely when the hood rose to the pedestrian's midline. According to the data, lower bumpers on autos with square front-end designs appeared to reduce the likelihood of pelvic and leg fractures.

Bibliography: 1

Status Report: Vol. 13, No. 6, May 8, 1978

32

Pelvic fractures by relative hood height



ISSUE: THE EFFECT OF VEHICLE SIZE AND WEIGHT ON INJURIES

Problem: In the mix of small and large, heavy and light vehicles on the nation's highways, what happens to people when those vehicles collide?

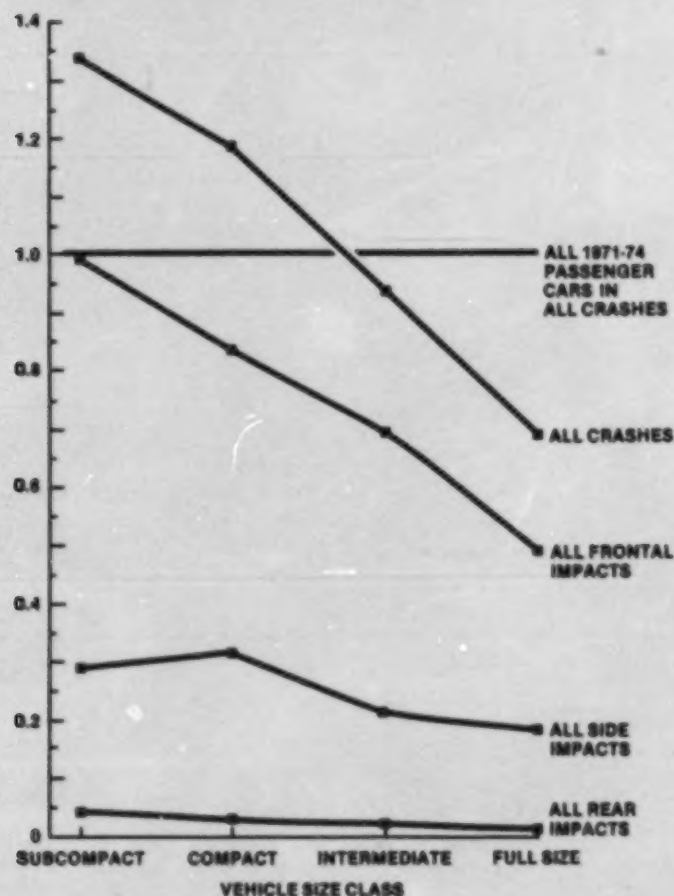
Institute Action:

☐ The Institute conducted a series of crash tests in 1971 in which different size cars were crashed head-on at moderate speeds. The tests showed that occupants of the smaller cars face dangers in crashes far greater than those faced by occupants of the larger cars. Pictures and results of the tests were given to appropriate government agencies, auto manufacturers, and the media. A narrated film of the tests, *Small Cars & Crashes*, has provided graphic proof of small-car hazards to thousands of viewers.

☐ This left the question as to whether vehicle size itself was important even in crashes of vehicles of equal weight. To answer this, the Institute sponsored research at the University of North Carolina which studied more than 150,000 cars involved in two-vehicle crashes and looked especially at two-car collisions in which both vehicles were of the same weight. The results showed large increases in occupant injuries as the weights of both vehicles decreased. The results also showed that the chances of severe injury and death increased especially rapidly in cars weighing less than 3,000 pounds.

☐ Further Institute analyses of data from the same work found that the separate influences of vehicle size and weight characteristics on the severity of crash injuries in two-car crashes led to "a crashworthiness design concept for intervehicle crashes that regards increase in vehicle size as primarily protective and increases in vehicle weight as primarily hostile." This

Relative passenger car occupant death rates
by car size and initial direction of impact—
1971-74 models in calendar year 1975



conclusion indicates the desirability of relatively sizable but not heavy vehicles. The Institute concluded that if adequate vehicle size can be obtained without substantial relative increases in weight, or alternatively if vehicle weight can be reduced without substantial reductions in vehicle size, occupants could be afforded greater crash protection without adding to the kinetic energy that must be absorbed or dissipated in crashes.

□ A comprehensive Institute study of different size vehicles in fatal crashes found that motorcycles and tractor-trailer trucks have dramatically higher fatal crash involvement rates than other vehicles, based on the numbers registered. The study examined the relationships between vehicle size and other factors in the 1,440 fatal crashes that occurred in Maryland during 1970 and 1971. The study dealt with motorcycles, cars categorized by size according to wheelbase, non-trailer trucks, and tractor-trailer units. The study showed strikingly different patterns of fatal crash involvement among vehicles of different sizes.

□ A study by researchers from Johns Hopkins University, the Institute, and the office of the chief medical examiner of Maryland examined 150 fatal crashes from 1970 to 1973 involving tractor-trailers. Nineteen of the crashes involved only a tractor-trailer, and 131 involved a tractor-trailer and at least one other vehicle. For all 150 collisions, only 24 percent of the deaths were to the occupants of the tractor-trailers. For the 131 multi-vehicle collisions, 14 percent of the fatalities occurred in tractor-trailers and 86 percent in vehicles other than tractor-trailers.

"In multi-vehicle collisions the tractor-trailer driver was rarely killed unless the other vehicle was also a tractor-trailer or heavy truck," the researchers re-

ported. "Fatal collisions involving a car and a tractor-trailer resulted in occupant death rates almost ten times as high in the car as in the tractor-trailer—56 percent compared to 6 percent."

One major factor influencing the chance of collisions between tractor-trailers and other vehicles was the heavy truck's inability to maintain speed on an upgrade relative to other traffic. The tractor-trailer was the lead vehicle in seven of the eight collisions known to have occurred on an upgrade.

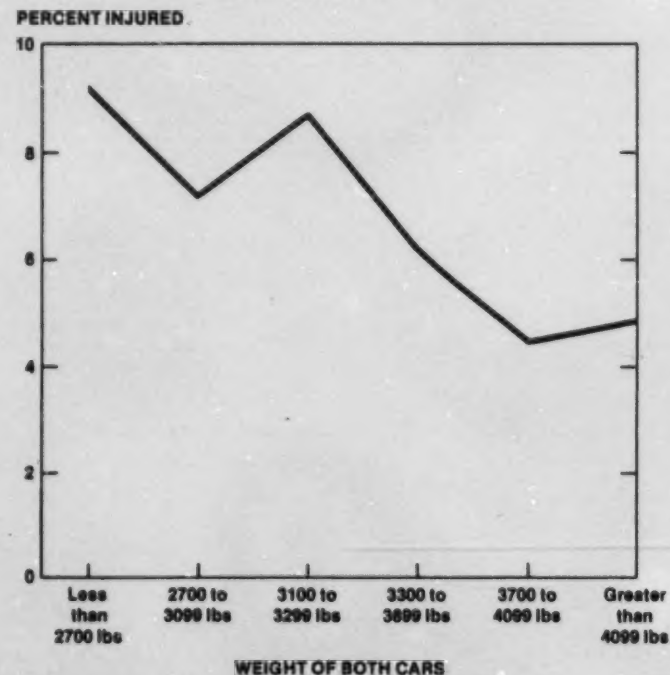
Tractor-trailers have poorer braking ability than cars and this increases their likelihood of being involved in crashes. Of the 31 rear-end collisions not known to have occurred on an upgrade, the tractor-trailer was the striking vehicle in 74 percent. The researchers reported that 63 percent of the multi-vehicle collisions involved configurations in which the tractor-trailer's braking ability may be especially likely to play a role.

□ An Institute study of 1975 car occupant deaths in the U.S. indicated that the occupant death rates of early-1970s models were "strongly and inversely related" to their sizes. Deaths were generally higher as car size decreased, and especially so in frontal crashes into other vehicles. Noting that frontal impacts account for almost three-fourths of the occupant fatalities and also exhibit the most pronounced relationship with car size, the study observed that, "The relationship between smaller cars and increased death rates is especially strong in frontal impacts with other vehicles." The report noted that as new cars are "downsized," deaths can be expected to increase accordingly until automatic restraints are provided. The report added that because the major crash mode in which small cars are especially hazardous is the frontal crash, much of the disadvantage presently faced by the occupants of small cars will disappear when these long-available technologies are provided.

Bibliography: 18, 27, 28, 65, 191, 203, 227

Status Report: Vol. 10, No. 13, July 30, 1975; Vol. 10, No. 12, July 9, 1975; Vol. 9, No. 14, July 26, 1974; Vol. 6, No. 21, Nov. 16, 1971

Severe and fatal injuries to unbelted drivers in front-into-front crashes of cars of equal weight



ISSUE: CAR CRASHWORTHINESS IN LOW-SPEED IMPACTS

Problem: The design of new automobiles, and particularly their bumpers, invites needless, avoidable damage in even the most minor front and rear collisions, and thus exacts a huge, wasteful economic penalty from consumers.

Institute Action:

☐ A continuing series of filmed low-speed crash tests of representative domestic and imported cars, initiated by the Institute in 1969, has accumulated extensive data on the inadequacies of auto design and documented the need for protection against costly low-speed impact damage. Results of tests of each year's models have shown new car designs to be characterized by lavish use of fragile and expensive sheet metal parts and chrome on exterior areas of the cars—areas likely to be impacted in very low-speed collisions such as parking-lot "fender benders"—and by bumper systems that fail to provide protection and sometimes even compound the damage. The Institute's crash-testing and the analyses stemming from it alerted government officials to the scope of the problem and has been a major spur to the initial governmental actions intended to counter the persistent problems of designed-in damageability in new cars.

☐ The results of the low-speed crash test program annually have been the subject of Congressional hearings aimed at focusing both public attention on the problem and the attention of the U.S. Department of Transportation on the need to require much better bumper performance on new cars. As its first response, DOT issued a vehicle safety standard, effective from the 1973 model year, requiring that new car front and rear-end designs protect safety related components—lights, windshield wipers, brake lines, and

others—from damage in very low-speed impacts, and reduce the likelihood of bumper mismatch in higher-speed collisions. Since DOT had no authority at the time to issue a vehicle standard to reduce designed-in economic losses from low-speed impacts, however, its safety standard was silent on the repair-cost problem and required no limitation of economic damage whatsoever.

☐ To provide DOT with that authority, Congress—after extensive examination of Institute crash test results and other evidence—passed the Motor Vehicle Information and Cost Savings Act of 1972, directing the department to set a new-car bumper standard to reduce economic damage in low-speed crashes. At the insistence of some car manufacturers the department delayed issuing such a standard but finally—after repeated testimony by the Institute and others as to the severity and needlessness of the designed-in damage problem, and repeated proddings by Congressional committees—the agency in 1976 issued a modest damage-reducing bumper standard to begin taking effect in the 1979 model year. Ironically, as Institute tests had shown, some cars on the road already were meeting the future standard and yet were incurring large amounts of totally avoidable damage in their low-speed impacts in the real world—demonstrating how weak the new department standard actually would be. This point was particularly emphasized in Institute testimony before the Senate Consumer Subcommittee in 1978.

☐ In 1977 and 1978 the Institute graphically demonstrated to Congress and the department that technology for improved bumper systems to cut the low-speed crash toll is readily available. A filmed report of an effective energy-managing bumper, developed by Tayco Corp. for a 1977 AMC Gremlin, was shown to the House Subcommittee on Consumer Protection and Finance and the Senate Consumer Subcommittee.

Crash

The film showed that a Gremlin with a standard bumper experienced an estimated \$236 of repair damage in a 5-mile-an-hour crash into an angle barrier—but an identical model, equipped with the Tayco bumper, had no damage. Nor was it damaged when driven 7 miles an hour into a barrier—a test surpassing the department's property-damage standard's requirement.

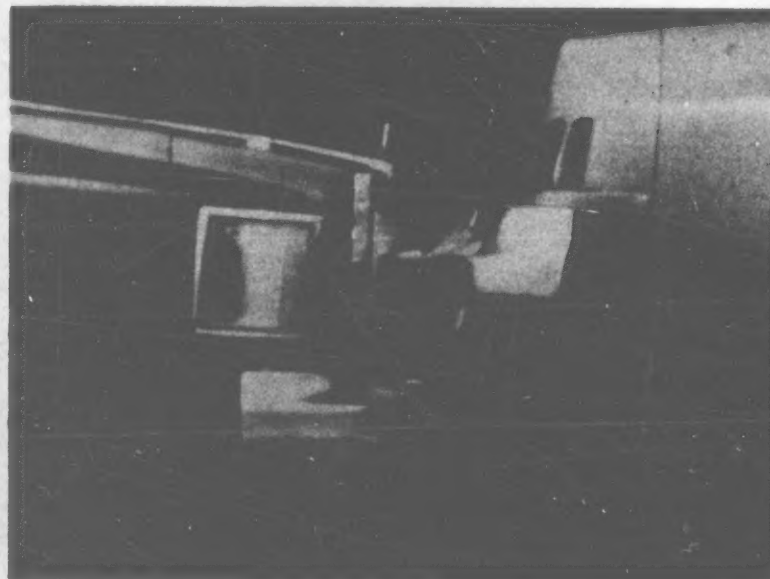
□ The Institute has published and makes available a summary analysis of progress and delays since 1969 in the development of federal standards to remedy the low-speed crash damageability problem. The summary, "A Thumbnail History of Federal Bumper Standards," points out that even as of the 1978 model year, "no federal standard was yet in effect to reduce the needless economic waste produced by ineffective, costly-to-impact and costly-to-replace bumper design on cars sold to the American public."

Bibliography: 56, 58, 75, 117, 138, 155, 157, 190, 194, 251, 254, 255, 257, 258, 262, 263, 265, 266, 267, 268, 270

Status Report: Vol. 13, No. 5, April 12, 1978; Vol. 12, No. 16, Nov. 8, 1977; Vol. 12, No. 13, Aug. 15, 1977; Vol. 12, No. 11, June 29, 1977; Vol. 12, No. 9, May 31, 1977; Vol. 12, No. 7, May 9, 1977; Vol. 12, No. 4, March 2, 1977; Vol. 11, No. 5, March 19, 1976; Vol. 11, No. 4, March 3, 1976; Vol. 10, No. 8, April 11, 1975; Vol. 10, No. 7, March 31, 1975; Vol. 10, No. 5, Feb. 21, 1975

36

As part of the Institute's annual low-speed crash test program, these two 1978 Chrysler Cordobas were impacted front-to-rear at 10 miles per hour. The tests revealed not only that the car bumpers' inadequate design allowed damage that would have been completely prevented by adequate bumpers, but also that the Cordoba bumper design induced the rear car to underide the front car, thus further aggravating the damage. Total estimated repair cost to both cars: \$669.



70

71

ISSUE: DEVELOPING LOW-COST CRASH RECORDERS

Problem: Without reliable, precise information on vehicle impact speeds, researchers are severely handicapped in studying the consequences of real-world crashes. Crash recorders—devices installed in motor vehicles to record impact severity—can provide such information, but recorders generally have been very costly.

Institute Action:

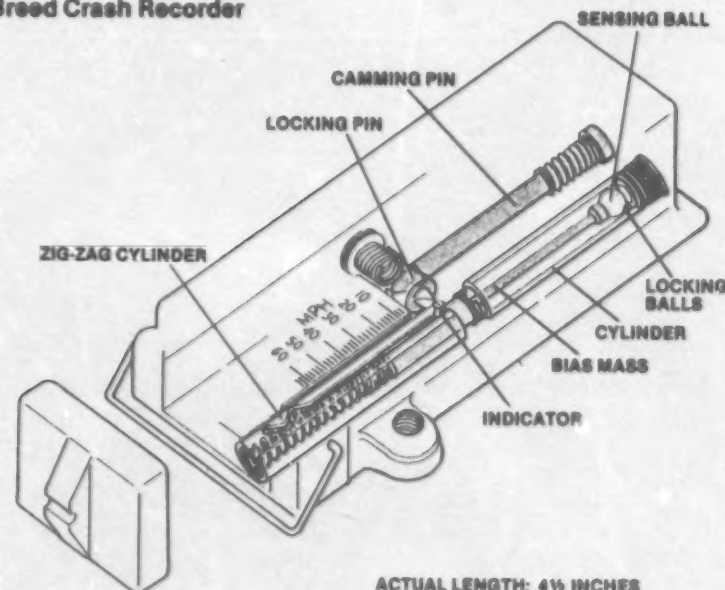
☐ The Institute has aided a scientific manufacturing company, the Breed Corporation, in developing a

low-cost, compact crash recorder that measures the velocity change experienced by the vehicle during a crash. In a laboratory evaluation of prototypes of the device, Institute representatives reported "the concept and design have great potential for application in motor vehicles." The recorder should be relatively inexpensive when produced in volume (less than \$10), and the Institute found the device simple to construct and operate, rugged, tamper-proof, and easy to read following a crash. Fabrication of a large number of the recorders for more comprehensive laboratory evaluation was recommended, followed by a large-scale demonstration program in vehicle fleets.

Bibliography: 202

Status Report: Vol. 10, No. 14, Aug. 14, 1975

Breed Crash Recorder



ACTUAL LENGTH: 4 1/2 INCHES

ISSUE: REAR UNDERRIDE COLLISIONS

Problem: When cars impact the rears of large trucks or truck-trailers, the resulting "underride" of the cars can mean serious injury or death—including death by decapitation—for occupants.

Institute Action:

☐ To demonstrate both the problem and the availability of solutions, the Institute in 1977 ran a series of crash tests in which, first, representative new cars were impacted into the rears of standard tractor-trailers at moderate speeds. As very slow-motion films of the tests showed, the cars underrode the trucks so severely that their passenger compartments were violated and their dummy occupants were smashed about violently. This was even though the truck-trailers were equipped with so-called "underride protection" devices that met the longstanding, still current federal safety standard. In fact, the "protection" devices collapsed on impact and, in one test, the device became an instrument of injury by intruding the car's passenger compartment and ramming the occupant dummy in the face and head.

In another phase of the same test series, the Institute equipped identical truck-trailers with effective, lightweight underride protection devices developed by Institute researchers for demonstration purposes. The devices successfully restrained impacting cars traveling at speeds even faster than those travelled by the cars striking the standard truck-trailers, and thus prevented both "underride" violation of the cars' passenger compartments by the trailer, and smashing of the dummy occupants.

☐ At the invitation of the Senate Consumer Subcommittee, the Institute showed the filmed results of its crash tests before a special oversight hearing. As a

consequence of the Institute's testimony and film, U.S. Department of Transportation officials were urged by the subcommittee's chairman to expedite action leading to a federal requirement for adequate, effective underride protection devices on the rears of trucks and truck-trailers. At the same hearing, the Institute emphasized that its designs—representing only one of the possible alternatives available for effective underride prevention guards—were being placed in the public domain for use without charge by all concerned.

☐ Following the hearings the Institute petitioned the U.S. Department of Transportation agencies to replace the present, meaningless underride protection standard—which covers only trucks already in interstate commerce—with an effective standard reflecting available technology, and to make the latter applicable as well to all new trucks built in future. The department responded by issuing an advance notice of proposed rulemaking intended to lead to such a standard.

☐ The Institute also moved to bring underride protection to an estimated two million intrastate heavy vehicles that would not be covered by federal standards. A petition was filed with the Vehicle Equipment Safety Commission to initiate regulations to establish underride standards for its member states. The commission consists of representatives of 42 states and the District of Columbia and was organized in 1963 to bring greater uniformity of laws regulating vehicle equipment.

Bibliography: 299, 300

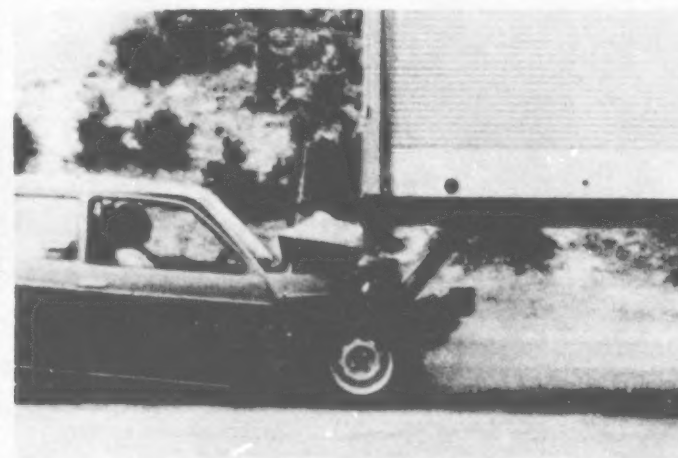
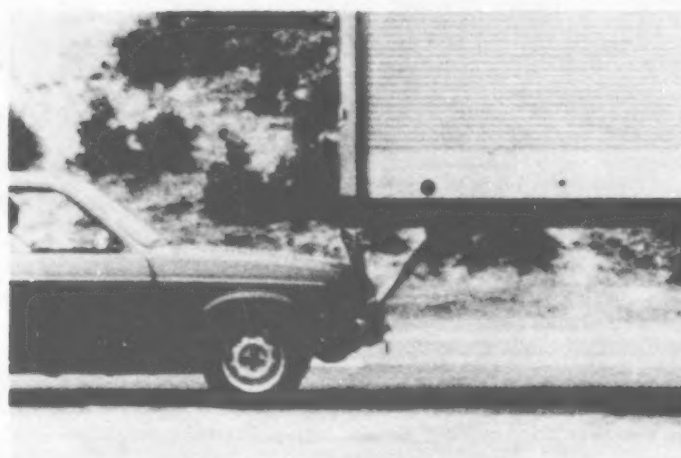
Status Report: Vol. 12, No. 15, Oct. 13, 1977; Vol. 12, No. 6, March 29, 1977



The Institute's underride crash test program showed, in the photos above, that truck rear underride guards meeting current federal standards are totally inadequate; on impact at 30 miles per hour by a 1976 Chevrolet Chevette, the conventional guard collapsed and allowed the car to underride, with huge amounts of resulting damage to its passenger compartment and the test-dummy occupant.

39

As shown in the photos below, however, in a similar crash test into an experimental guard developed by the Institute, the passenger compartment of an identical Chevette remained intact and the dummy was protected against intrusion by the truck's structure.



73

77

ISSUE: MEAT-AXE HOODS

Problem: In frontal crashes, some auto designs permit the hood to slash through the windshield, in meat-axe fashion, and invade the passenger compartment.

Institute Action:

- ☐ In November 1971, the Institute reported to the National Highway Traffic Safety Administration that



in its initial series of medium speed head-on crash tests, the hood of a 1971 Chevrolet Vega sliced through the car's windshield in a 43-mile-per-hour crash with a 1971 Chevrolet Impala. Subsequently, NHTSA proposed rulemaking in 1972 and 1974 for a standard designed to prohibit hoods from penetrating windshields in crashes.

Finally, in 1975, the standard was issued to take effect with the 1977 model year. The new standard establishes a "protected zone" in front of the windshield that may not be penetrated in a 30 mile per hour frontal barrier crash.

Status Report: Vol. 6, No. 21, Nov. 16, 1971

ISSUE: TRUCK CAB DESIGN HAZARDS

Problem: Taking into account the numbers of heavy trucks and other vehicles registered, do occupants of tractor-trailers have a greater risk of being fatally injured than do drivers of other types of vehicles, and how often do truck driver fatalities involve impact with the steering wheel?

Institute Action:

- ☐ The Institute and the Maryland Medical-Legal Foundation supported a Maryland study that found substantially more occupant deaths per registered vehicle for tractor-trailers than for cars. "According to the National Highway Traffic Safety Administration's Fatal Accident Reporting System, 1.5 percent of the occupant fatalities in 1975 were occupants of tractor-trailers and other truck combinations, a group of vehicles that comprises only 0.8 percent of vehicle registration in the United States," the researchers reported. "This means that a truck tractor is far more likely than the average vehicle to be involved in a

crash in which one of its occupants is killed, and that special attention to protection of truck tractor occupants is therefore appropriate."

The study found that of 68 truck driver fatalities in a two-year period in Maryland, 54 were from impact with the interior of the occupant compartment, most notably contact with the steering wheel. The researchers noted that a number of standards affording crash protection to automobile occupants—including those limiting rearward movement of steering wheels in crashes and requiring steering assemblies to be energy-absorbing to cushion the body of the impacting driver—have not yet been extended to trucks and that truck drivers do not use seat belts with great frequency. The researchers concluded that "the fact that a medical examiner can still autopsy the driver of a late model truck and report 'typical steering column injuries' epitomizes . . . [the] failure to take obvious and available steps to prevent injuries of long recognized etiology."

☐ Citing the Maryland study as evidence of the need, the Institute asked the National Highway Traffic Safety Administration to modify existing safety standards on energy-absorbing steering assemblies and steering control rearward displacement so as to apply them to multipurpose passenger vehicles, trucks, and buses of up to 10,000 pounds gross vehicle weight rating. The agency subsequently stated that it planned to do so.

Bibliography: 141

Status Report: Vol. 12, No. 18, Dec. 23, 1977; Vol. 12, No. 15, Oct. 13, 1977

ISSUE: EFFECTIVENESS OF SAFETY STANDARDS

Problem: Have federal safety standards for motor vehicles produced tangible reductions in damage to people?

Institute Action:

☐ In 1971 the Institute supported a study by the Highway Safety Research Center of the University of North Carolina on the effectiveness of seat belts (when worn) and energy-absorbing steering assemblies, both required by federal standards, in reducing injuries to drivers. Significant injury reductions were found to be associated with the steering assemblies for medium-speed frontal impact crashes and medium-speed ran-off-the-road crashes—approximately 30 percent. The seat belts also proved to be somewhat effective in reducing injuries in those two types of crashes, as well as in higher-speed crashes. The combined reduction from the steering assembly plus the belts was approximately 43 percent.

☐ The Institute supported another study by HSRC several years later to determine the effectiveness of lap and shoulder harnesses in preventing injuries and deaths. Among the findings of that study: In single vehicle crashes, lap-belted drivers experienced 66 percent fewer serious and fatal injuries than expected in medium-speed collisions, based on the experience of the unbelted sample, and 53 percent fewer serious and fatal injuries in high-speed collisions. Lap-belted drivers had 43 percent fewer serious and fatal injuries than their unbelted counterparts in frontal impacts when all crash types and speeds were combined. Lap-belted right front seat passengers experienced 37 percent fewer serious and fatal injuries in frontal collisions of all crash types and speeds combined. For frontal impacts, none of the 29 drivers and right front seat pas-

sengers wearing a shoulder harness experienced a serious or fatal injury. This was significantly lower than both the lap-belted and unbelted groups in comparable crashes.

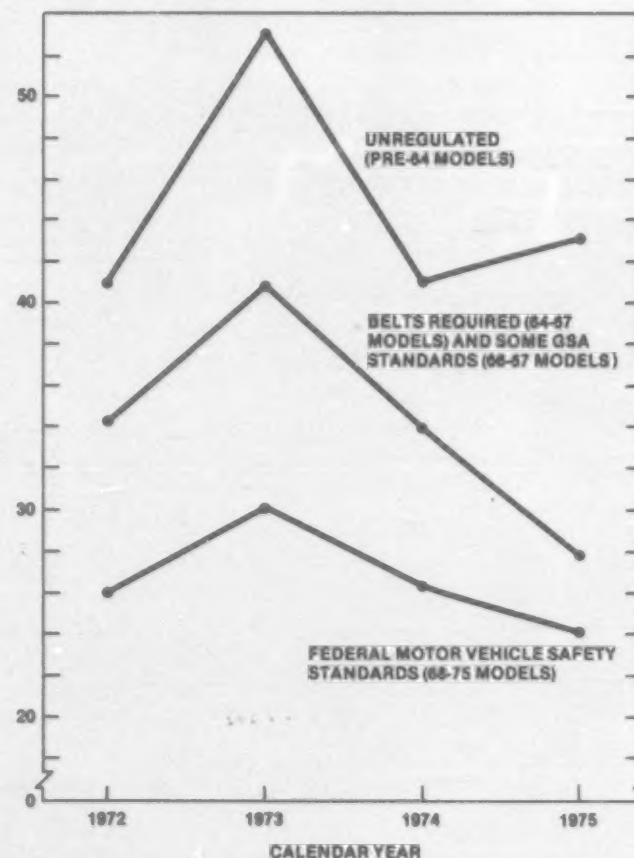
□ In a comparison of cars manufactured prior to federal and many state motor vehicle safety regulations and cars manufactured in compliance with such regulations, the Institute found substantial reductions in occupant fatality rates for the models manufactured in compliance with safety standards. Models prior to 1964 and unaffected by such federal or many state standards had an average yearly occupant fatality rate of 44 per 100,000 registered cars. For 1964 to 1967 models, with front outboard lap seat belts required by state law and some crash protection installed as the result of General Services Administration standards, the fatality rate had dropped to 35 occupant deaths per 100,000 registered cars, or 20 per cent less than in pre-1964 cars.

For post-1967 models—those cars coming under the initially-issued federal motor vehicle safety standards—the fatality rate had declined still further; occupant deaths averaged 27 per 100,000 registered cars, 23 percent less than for the 1964-1967 models and 39 percent less than for pre-1964 models.

The study was based on all reported fatal crashes in Maryland during 1972-1975, and on Maryland motor vehicle registration data. No consistent differences were found for the years of study in the rates of pedestrian fatalities, leading the researchers to conclude, "Regulations promulgated thus far have had no apparent effect on pedestrian fatality rates."

The findings of effectiveness of motor vehicle safety regulations were later confirmed by a study conducted by the federal government's General Accounting Office, using data from crashes in North Carolina and New York.

Car occupant fatalities per 100,000 registered cars by type of new-car safety regulations Maryland, 1972-1975



☐ Three Institute staff members, in a paper presented before the Fourth International Congress on Automotive Safety in 1975, described basic concepts and rules for comprehensively evaluating federal motor vehicle safety performance standards. "The first stage of an evaluation . . . should be a statistical comparison indicating whether or not the performance requirements of the standard, however implemented, are reducing the target damage to people and other associated societal losses," they said. "The second stage should be a more clinical and in-depth measurement of the performance, in reducing the target losses, of the various design alternatives chosen by the manufacturers to meet the standard under scrutiny, to determine whether some designs have more payoff than others." Without such an evaluation, the paper points out, there can be "no justification for weakening or revoking an existing standard."

Bibliography: 33, 176, 196, 223, 225

Status Report: Vol. 12, No. 8, May 17, 1977; Vol. 11, No. 14, Aug. 30, 1976; Vol. 11, No. 7, May 3, 1976; Vol. 10, No. 18, Nov. 5, 1975; Vol. 9, No. 22, Dec. 10, 1974

ISSUE: ROADSIDE BOOBYTRAPS

Problem: America's roadsides, including those along the most modern high-speed expressways, are lined with hazards such as concrete bridge abutments, stub-ended guardrails, rigid sign posts, telephone poles, and a host of other boobytraps that turn minor off-the-road mishaps into major crashes that needlessly kill and injure vehicle occupants. Technological solutions to the roadside boobytrap problem have existed for years, but they have not been sufficiently utilized. The result is many thousands of deaths and injuries each year that would not otherwise occur.

Institute Action:

☐ A feature-length documentary film, *Boobytrap!*, produced by the Institute and Harvest Films, described the national roadside hazard problem, along with the many available solutions, in graphic detail. The film was first presented, by invitation, to the Senate Public Works Committee at a hearing considering a proposed law to allocate a portion of Federal Highway Trust Fund money specifically for the correction of roadside hazard problems. The law was enacted and, as a result, funds were obligated for the dismantling of roadside hazards and their replacement with impact-managing structures and cleared "recovery areas" along highways. Since its premiere in 1972, *Boobytrap!* has had extensive television and local audience showings and has become a major influence in alerting the public to roadside hazards and the means of correcting them.

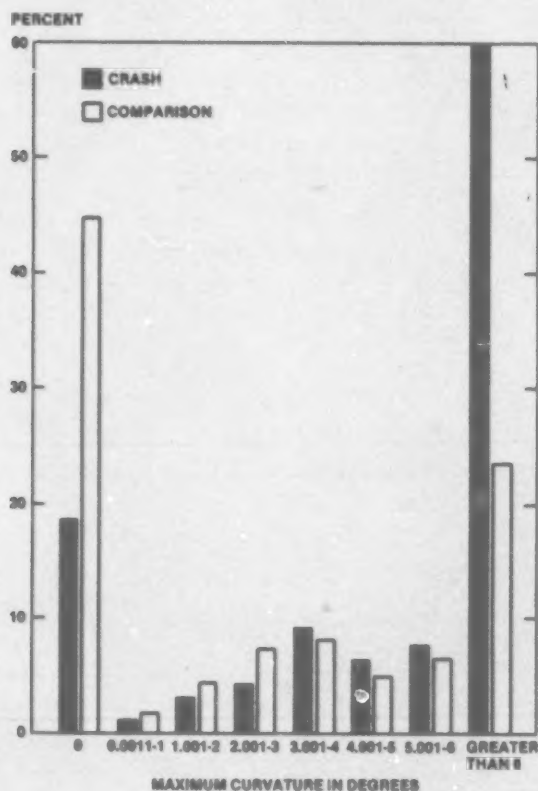
☐ Working with Institute staff, four attorneys from the Washington firm of Arnold & Porter carried out a full-scale analysis of accountability for roadside hazards and the legal options available for forcing their removal and preventing their future construction or reconstruction. The analysis was published as *The Law and Roadside Hazards* by the Michie Company. Issues covered included the legal liability of public and private organizations and the personal liability of officials, contractors, designers, and others responsible for roadside hazards. The book also examines strategies for employing federal and state laws to prevent or remove hazards.

☐ To help highway officials to determine rationally and systematically the kinds of road locations to give priority in making engineering changes to reduce deaths from roadside hazards, the Institute in collaboration with the Georgia Institute of Technology surveyed 300 sites that had accounted for nearly all of

43

the fatal, off-the-road crashes in 108 Georgia counties over a 14-month period. To determine criteria by which the most dangerous road locations might be identified, the researchers studied road characteristics such as curvature and grade at the fatality sites, as well as location of the roadside hazards, and compared these conditions with those back along the roads the fatally crashing vehicles had travelled without crashing. The findings showed that highway officials should give top priority to hazard modification

Maximum roadway curvature up to 152 meters from fatal fixed object crash and comparison sites



on both sides of nonlocal roads "on and near curves greater than 6 degrees, particularly those accompanied by downhill grades of 2 percent or steeper."

Trees were the hazards most often struck by vehicles, the research found. Other hazards involved in the fatal crashes included embankments and ditches, utility poles, guardrails, signs, and bridge abutments.

□ Police were recruited to help identify roadside hazards in a demonstration project sponsored by the Institute and the International Association of Chiefs of Police. Idaho state police canvassed more than 700 miles of highways in one state highway district and identified more than 4,000 probable roadside hazards. The police officers' reports were reviewed by the Idaho Division of Highways, and corrective measures were planned. The work showed that the police can do an excellent job of identifying roadside hazards needing correction by highway personnel. While preparing the needed inventory of hazards, they gained a new awareness of highway conditions. "Police officers involved in the project stated that they have become more sensitive to the negative role of roadside hazards in highway crashes," researchers explained in the project report. "In contrast, at the start of the project, many officers could not adequately define a roadside hazard."

Bibliography: 41, 123, 126, 139, 150, 259, 264, 274, 279, 291, 292, 295

Status Report: Vol. 11, No. 15, Sept. 23, 1976; Vol. 11, No. 4, March 3, 1976; Vol. 10, No. 1, Jan. 10, 1975; Vol. 7, No. 19, Oct. 16, 1972



45

Two persons were killed and three injured in the crash shown above, which occurred in April 1970 on an Illinois highway. The car was torn in two by the rigid steel signposts. Despite this, the sign was left in place, and in May 1973 another crash into the same signposts critically injured two persons (picture above right). The tragic events finally resulted in installation of a new sign on breakaway posts, set back from the edge of the pavement (picture at right).

83



89

Postcrash

ISSUE: CRASH FIRES

Problem: Postcrash vehicle fires can turn crashes into holocausts that result in needless death and injury.

Institute Action:

☐ In a series of controlled, front-to-rear moderate-speed crash tests using new cars, the Institute found

that auto fuel tank design deficiencies allow fuel system ruptures, fuel leakages, and the potential for lethal postcrash fires. Six tests were conducted; in each, the front of a moving vehicle struck the rear of a parked one at a speed less than 40 miles per hour. Fuel systems of the struck cars ruptured in every test; in one, fire broke out spontaneously and destroyed the passenger compartment of the struck vehicle in moments. Further, in five of the tests, car doors—



escape routes in the event of fire—jammed.

On learning of the fuel tank crash research, the House Commerce Committee immediately held hearings to examine the filmed results. Those hearings, and a National Highway Traffic Safety Administration proposal issued soon after as a direct result of the Institute's work and Congressional demands, led to passage of a law and adoption of a motor vehicle safety standard requiring that new cars, starting with the 1977 model year, be designed to withstand front-angular, lateral moving, and rear moving barrier crashes. After each crash, a rollover test is required. The new standard also specifies the amount and rate of allowable fuel spillage following both barrier crashes and rollovers. An earlier, front-end crash standard remains in force.

☐ Two studies conducted for the Institute by Robert R. Nathan Associates found that in 1973 almost \$350 million of America's fire department costs were associated with vehicle fires and related incidents, an amount equal to nearly 10 percent of all the country's fire fighting costs, and that motor vehicle fires had been increasing at a rate of more than 10 percent annually, or five times the rate of increase for building fires.

☐ Based on its fuel tank crash test films, the Institute, with Harvest Films, produced a documentary-length movie entitled, *Cars That Crash and Burn*. In wide distribution across the country, the film was excerpted for extensive use on ABC-TV's "Close-Up: Fire!"—a one-hour special that has won two Emmy awards.

Bibliography: 247, 248, 265

Status Report: Vol. 10, No. 3, Feb. 5, 1975; Vol. 9, No. 13, July 8, 1974; Vol. 8, No. 11, May 29, 1973

ISSUE: HOW ADEQUATE IS EMERGENCY CARE?

Problem: How accurately and expeditiously are the injured being treated after highway crashes?

Institute Action:

☐ An Institute-sponsored research group, drawn from Johns Hopkins and the Maryland Medical-Legal Foundation, conducted a detailed medical investigation of 33 highway fatalities that resulted from abdominal injuries, all but one of whom reached hospital care alive. Nearly half of the cases studied showed either a failure to operate or excessive delay in operating; these lives "might possibly have been salvaged by prompt and proper diagnosis and treatment." The study recommended that injured persons be transported to hospitals equipped to deal with major trauma.

☐ A survey of emergency services in Vermont led an Institute-supported researcher from the University of Vermont to conclude that "almost a quarter of Vermont's highway fatalities die of definitely or possibly survivable injuries," largely as a result of inadequate emergency services. The same researcher later studied and published a report on Vermont's ambulance service. He found a significant upgrading of services due to a voluntary state grading system.

☐ A study by University of Illinois and Johns Hopkins workers of maxillofacial injury treatment in emergency rooms reviewed the role of auto crashes in this type of injury and made specific recommendations to emergency room personnel regarding treatment.

Bibliography: 2, 5, 14, 47, 276

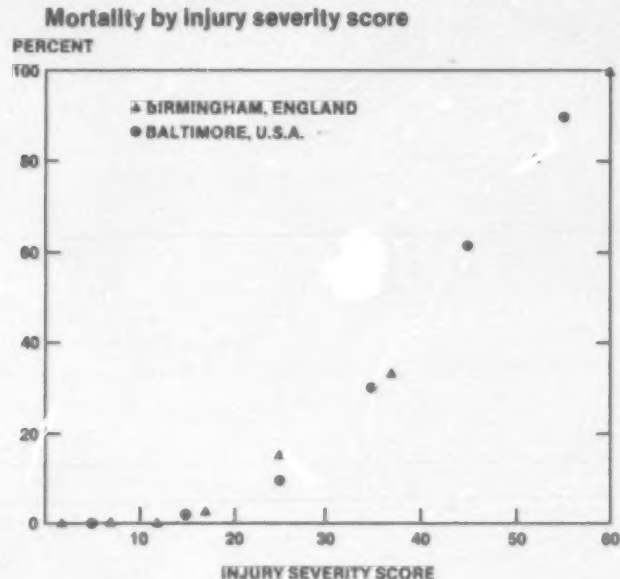
Status Report: Vol. 6, No. 20, Nov. 1, 1971; Vol. 5, No. 21, Dec. 1, 1970

ISSUE: ASSESSING INJURY SEVERITY

Problem: In order to make detailed evaluations of the efficacy of improvements in vehicle crash design in reducing injury, and to measure the success of different emergency care approaches, it is often essential to be able to compare groups of people whose injuries vary greatly in number, body location, and severity. Yet systems to numerically assess the severity of individual injuries had not been adequate to measure the cumulative severity of multiple injuries.

Institute Action:

□ In a joint program, research workers from the Institute, Johns Hopkins University, and the Maryland Institute for Emergency Medicine developed an "Injury Severity Score" that enables medical personnel and researchers to make an assessment of multiple as well as single injury severities. The Injury Severity



Score was developed from a study of more than 2,000 serious and fatal injuries. It is based on the commonly used Abbreviated Injury Scale, and involves squaring and adding the Abbreviated Injury Scale grades for injuries sustained in the three most severely injured areas of the body. This allows evaluation of multiple injuries and provides a much better prediction of the outcome than is possible with the Abbreviated Injury Scale alone.

The work also demonstrated that with similar Injury Severity Scores, persons in the 50-69 year old group are more likely to die than younger persons, and that the likelihood increases substantially for those age 70 and older.

The research also showed that among persons fatally injured, the greater the severity score, the shorter the time from injury to death.

The Injury Severity Score, developed in 1974, already is in wide use. The Abbreviated Injury Scale has been revised, due in part to development of the Injury Severity Score. Both reflect the increasing sophistication of many of the techniques being used in high-way loss reduction research and programs, and in the injury control field generally.

The validity of the ISS was confirmed by medical researchers in England who found that the ISS of groups of injured patients closely correlates with their mortality in the same way as in the U.S. Their work also demonstrated the value of the ISS in studying such things as duration of hospital stay and severity of disability. A second study in Illinois by J. L. Semmlow and R. Cone suggests that it may also be valid to apply the ISS to non-vehicular trauma.

Bibliography: 10, 12, 20

Status Report: Vol. 12, No. 4, March 2, 1977; Vol. 9, No. 7, April 9, 1974

ISSUE: MOTORCYCLE DEATHS AND INJURIES

Problem: There has been a substantial rise in the number of motorcycles in this country. What is the role of the motorcycle in highway losses?

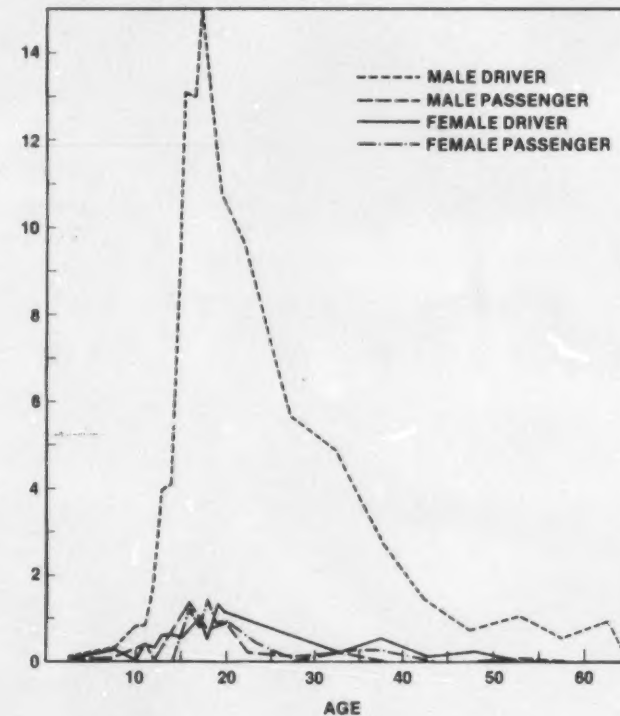
Institute Action:

□ The magnitude of serious multiple injuries suffered by motorcyclists in crashes is "striking," according to a study carried out for the Institute by University of California researchers. The study found that the problem centered on the male driver, especially when young. Fractures were the most frequent type of significant injury and were accompanied by an average of about two additional serious injuries. Motorcyclists who suffered chest or abdominal injuries had, respectively, an average of 3.1 and 2.8 additional serious injuries. Although severe head injuries represented only 12.7 percent of the injuries observed, they accounted for half of the 18 fatalities found in the study. (California had no motorcycle helmet law.)

The researchers found that almost 5 percent of all registered motorcycles in Sacramento County were involved in an injury-producing collision during the year. While the annual incidence rate of motorcycle collision injuries in the county was 2 per 1,000 population, the rate peaked at 14 per 1,000 population for 18-year-old male drivers. In addition to age, risk of injury was found to be associated with short stature of a driver operating an intermediate or larger size motorcycle, and with engine size. Two-thirds of the injury-producing collisions involved a motorcycle and a second motor vehicle. The study also found that police records may seriously under-report the number of motorcycle-related injuries. Fewer than 39 percent of all injured motorcyclists were reported in official police records.

□ An Institute study of vehicles in fatal crashes in Maryland found that motorcycles have "markedly higher rider death rates than other vehicles—three and a third times those of the smallest cars." Such a high rate of involvement of motorcycles in fatal crashes per years registered is especially noteworthy, the study observed, because their average exposure, in terms of miles traveled, is substantially less than that of cars and trucks. "Thus, if it had been possible to calculate fatal crashes per miles driven, motorcycle

**Incidence of motorcycle collision injury
rate per 10,000 population
Sacramento County, California, 1970**



Results

death involvement would have been even worse relative to larger vehicles than that found in the analysis employed," the researchers explained.

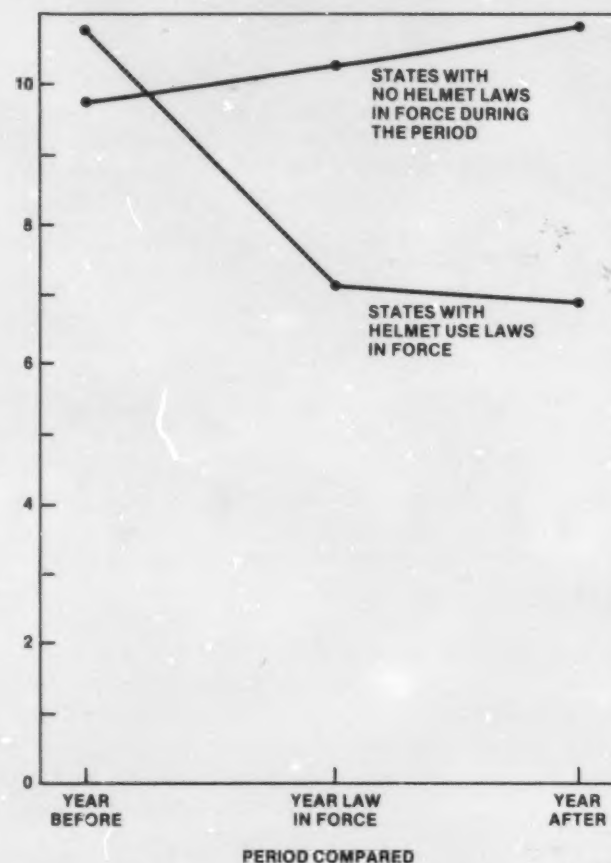
□ To determine the effect of state helmet use laws on motorcyclist fatalities, the Institute studied the fatal crash involvement rates in eight states that adopted helmet laws, compared with similar states that had no such laws during a comparable period. The study found that the average fatal involvement rate for the eight states that enacted helmet use laws declined from more than 10 per 10,000 registered motorcycles the year before the laws' enactments to about seven per 10,000 registered motorcycles, both in the years of enactments and the following years. In contrast, the average fatal involvement rate in the eight matched states that enacted no helmet laws at the time that their comparison state did so remained at about 10 per 10,000 registered motorcycles through the period studied.

A companion study of daytime motorcycle headlamp use laws found that the proportion of fatal crashes involving motorcycles decreased from that of the prior year in each of the states enacting such laws relative to the total such fatalities in it and its comparison state. The conclusion that daytime headlamp use laws were responsible for these reductions in fatalities "must be tempered by consideration of the possibility that the states changing headlamp laws were not sufficiently comparable to the available comparison states," the study cautioned. The findings, however, were believed "sufficiently encouraging to justify their consideration in states that do not now have headlamp use laws." Subsequent work by the University of North Carolina confirmed the effectiveness of motorcycle headlamp laws.

Bibliography: 35, 169, 171, 172, 173, 223, 227

Status Report: Vol. 12, No. 9, May 31, 1977; Vol. 10, No. 12, July 9, 1975; Vol. 9, No. 10, May 15, 1974

Fatal crash involvement per 10,000 motorcycles for states with helmet laws and comparison states



ISSUE: BICYCLE-MOTOR VEHICLE COLLISIONS

Problem: Bicycle use is growing rapidly. What are the characteristics of bicycle-motor vehicle collisions?

Institute Action:

☐ In a study of police reports of almost 900 injury-producing collisions between bicycles and motor vehicles, Institute researchers found that bicyclists—or their bicycles—were probably responsible in 78 percent of the crashes. However, the percentage of “probably responsible” bicyclists diminished sharply with increasing age. Ninety-two percent of the bicyclists under age 12 were found to be responsible, but only 34 percent of those older than 25. During daylight hours, bicyclists were usually responsible for crashes. However, in darkness, the motorist was most often responsible. Seventy-one percent of the collisions occurred in residential areas, 67 percent at intersections.

Bibliography: 285

Status Report: Vol. 9, No. 22, Dec. 10, 1974

ISSUE: PEDESTRIAN DEATHS

Problem: What types of drivers and pedestrians are involved in collisions producing pedestrian death? Who is at fault?

Institute Action:

☐ Johns Hopkins University and Institute researchers conducted a detailed examination of fatal pedestrian collisions occurring in Baltimore during a three-year period. Their findings included the following:

Almost half of the drivers studied were categorized as “probably negligent.” Of the remaining drivers, 37 percent were classified as “probably not negligent” and for 17 percent, no estimate of negligence could be made.

Of the drivers categorized as “probably negligent,” 58 percent had poor driving records. Only 39 percent of the “probably not negligent” drivers had poor records.

Three-fourths of the fatally injured pedestrians were either under the influence of alcohol, less than 10 years of age, or 65 years or older.

The researchers concluded that pedestrian injuries will not be effectively reduced by traditional safety campaigns that concentrate on changing pedestrian behavior because such programs fail to recognize that pedestrians most likely to be killed are those whose behavior is hardest to influence. They warned that the prominence of driver negligence indicates that even the prudent pedestrian risks being killed as long as he shares his route with motor vehicles.

Bibliography: 7, 11, 15

Status Report: Vol. 8, No. 1, Jan. 3, 1973

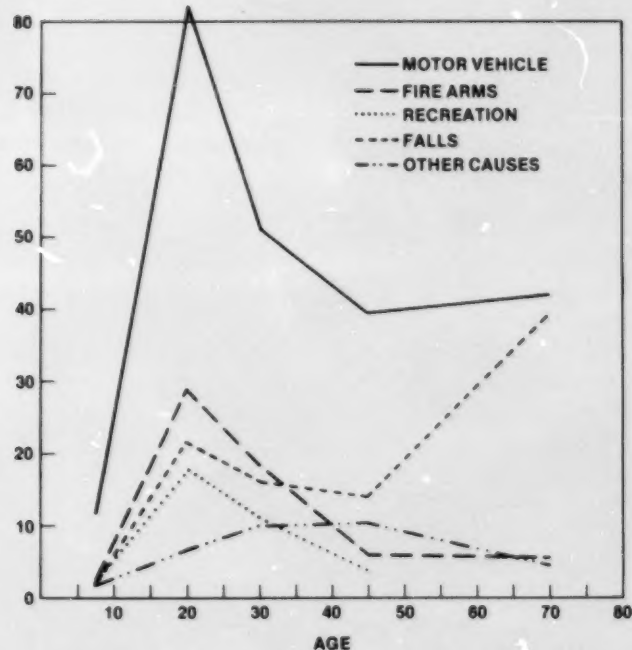
51

Results

ISSUE: MOTOR VEHICLE CRASHES AND SPINAL CORD INJURY

Problem: The spinal cord is the principal pathway by means of which the brain and the rest of the body maintain communication. When the cord is injured, the results are catastrophic, and commonly include paraplegia, quadriplegia, or death. What role do motor vehicle crashes have in producing such injuries, and how much do these tragic injuries cost the United States annually?

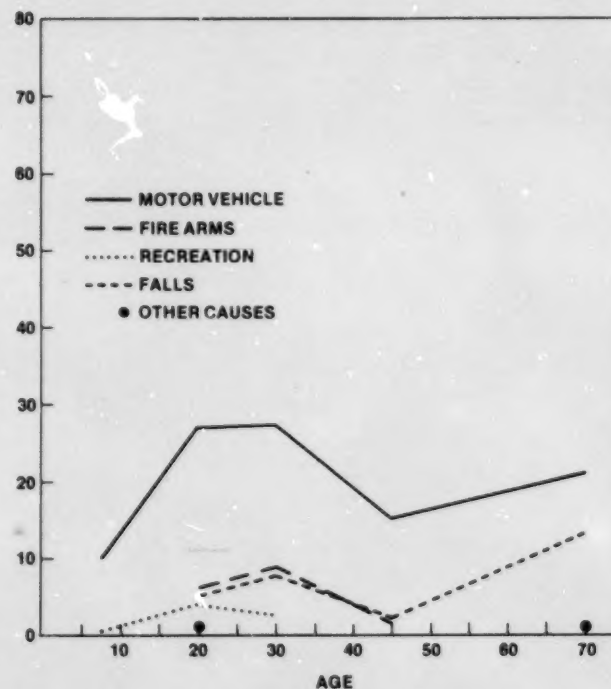
Average annual cause-age-specific incidence rates of spinal cord injury per million males: 18 Northern California counties, 1970-1971



Institute Action:

□ In 1971, the Institute arranged with the departments of Community Health and Orthopaedic Surgery, School of Medicine, University of California at Davis, to gather basic data on spinal cord injury cases in 18 northern California counties totalling nearly 6 million in population. The research found that more than one-half of all new cases of traumatic spinal cord damage were the result of motor vehicle crashes. Of these, 70 percent involved vehicle occupants, 20 percent pedestrians, and 10 percent motorcyclists.

Average annual cause-age-specific incidence rates of spinal cord injury per million females: 18 Northern California counties, 1970-1971



□ The next step was a study sponsored by the Institute which used the California data and other information to estimate both the numbers and cost of such motor vehicle-related spinal cord injuries occurring each year nationally. The results were published in a book, *The Costs of Motor Vehicle Related Spinal Cord Injuries*. This estimated that 5,315 persons suffered spinal cord injuries in the United States in 1974 in motor vehicle crashes, and of those, 1,938 died at the crash scene or before reaching the hospital. Of those admitted to the hospital, 1,091 were classified as quadriplegics with permanent impairment, 1,501 were paraplegics with permanent impairment, 447 died in the hospital, and 338 functionally recovered. Males outnumbered females by more than two to one among those suffering spinal cord injuries, and about 55 percent of the injured were between the ages of 16 and 35, in comparison with only 32 percent of the general population in this age group.

The study also estimated that in 1974 dollars these annual totals of new motor vehicle spinal cord injuries were costing the United States \$827.5 million in additional costs. Direct costs of the injuries, including such items as hospitalization and lifetime care, were estimated at \$248.6 million, while indirect costs, including lost wages, insurance costs, and legal expenses, came to \$578.8 million.

□ The Institute-supported California researchers also determined the longevity of persons with spinal cord injuries and found that of those who survived at least 24 hours, 84 percent were still alive after four years. Slightly more than 27 percent of the total cases studied died within the first hour, 40 percent within the first 24 hours, and 50 percent within four years from the time of the injury. Persons 65 years of age and older and individuals with massive multiple injuries were found to have the poorest survival rates. Persons suffering spinal cord injuries also had differ-

ing survival rates depending on the circumstances of injury. Those injured in motor vehicle crashes or by gunshot wounds had poorer chances of survival than those injured in falls or in diving. Among the motor-vehicle-related injuries, pedestrians had by far the poorest survival rates.

Bibliography: 170, 174, 242

Status Report: Vol. 11, No. 20, Dec. 15, 1976; Vol. 9, No. 19, Oct. 29, 1974

Summary of total expected societal costs
of motor vehicle related spinal cord injuries
sustained in the United States in 1974



TOTAL SOCIETAL COSTS—\$828 MILLION

Results

ISSUE: UNREPORTED CRASH DAMAGE

Problem: It has long been known informally that some of the impact damage sustained by vehicles, especially the less severe, is never reported to public agencies or insurers, and, furthermore, that such damage frequently remains unrepaired, at least for some time.

Institute Action:

□ Two surveys, initially organized independently by the research departments of State Farm and the Institute, were conducted to determine the magnitude and frequency of unrepaired crash damage to automobiles. The results were combined in a single report. In the report, nearly 20 percent of current models were estimated to accumulate unrepaired damage annually. As the report pointed out, crashes that produce minor damage are "not rare events that only deviant drivers experience, but, in fact, are very common events experienced by a majority of vehicles and their drivers."

□ A resulting position paper pointed out the implications of unrepaired crash damage for cost-benefit analyses. It said that "the present state of knowledge on the frequency and amount of unreported crash damage is too limited to enable this essential component to be adequately incorporated into cost-benefit analyses of bumper designs."

Bibliography: 30, 31

Status Report: Vol. 10, No. 8, April 11, 1975; Vol. 8, No. 17, Sept. 10, 1973

ISSUE: CRASH LOSS DATA

Problem: What are the loss characteristics—both for injury and property—of the many makes and models of recent model cars on the highways, as well as of classes of cars? How do loss frequencies and sizes vary between individual makes and models, and between car classes?

Institute Action:

□ In 1971, the Institute planned the development of a computerized collection and analysis system to utilize insurance coverage and claims data to determine the loss characteristics of different makes, models, and classes of automobiles. The system was based substantially on the analysis of Vehicle Identification Numbers by a complex computer program known as VIN-DICATOR, which identifies the makes, models, and series of individual vehicles. The computer program, updated annually since, continues to be used as a basic data analysis tool by a number of private and university research organizations, insurers, and state agencies, and the federal government.

□ In 1972, the Highway Loss Data Institute (HLDI) was created. HLDI is a public service, nonprofit research organization closely related to the Institute and supported by it. HLDI publishes up-to-date, reliable data about the loss characteristics of different vehicles, and makes these available without charge to the public, government agencies, and insurers. It compiles and publishes comparisons for most kinds of automobiles, based on large volumes of computerized claim and coverage data made available to it by a number of insurance companies. Its reports have consistently shown that there are large variations in collision and injury loss experience among similar vehicles, as well as among cars in different vehicle classes. For example, large increases in injury losses associated

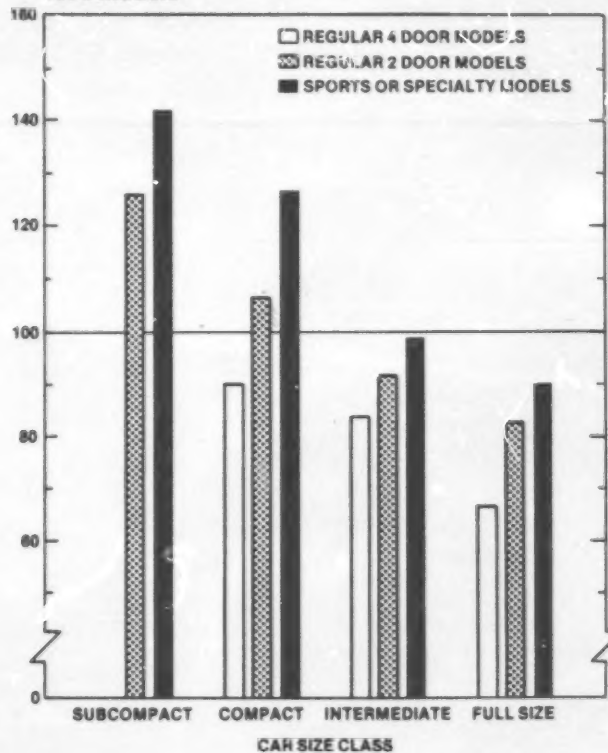
with decreasing car size have been repeatedly documented, a pattern which has been found to be even more pronounced in the case of cars driven by youthful operators. Information garnered by HLDI provides, in addition, special studies whose results have shown, for instance:

—the substantially greater effectiveness of *passive* safety belts is provided in some models of Volkswagen Rabbits during the 1977 model year, in reducing the frequency of injury claims from those experienced by such cars with *active* belts;

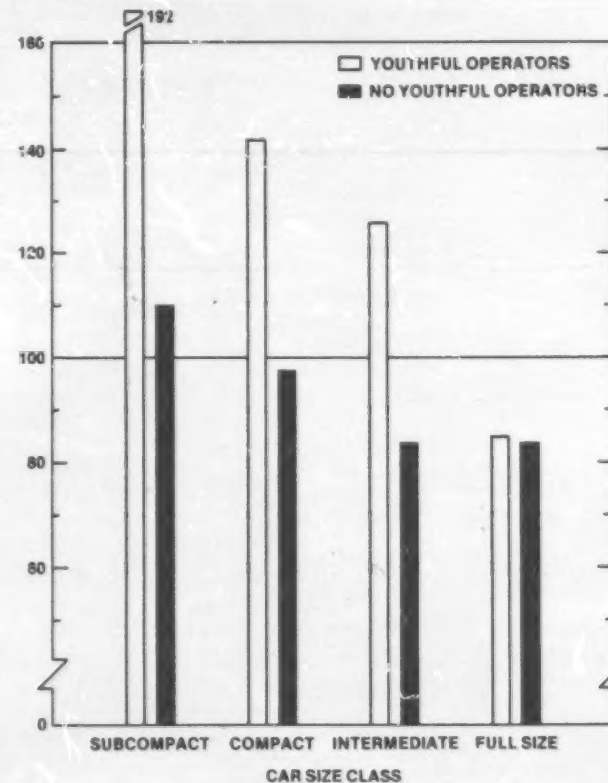
—higher frequencies and amounts of collision claims experienced by two-door models compared to corresponding four-door models;
 —increased losses associated with more powerful engines;
 —strong relationships between collision coverage insurance losses and registered vehicle density per square mile.

HLDI serves as a major source of both data and software assistance to the Institute. The insurance data

Medical payments insurance coverages
relative injury claim frequencies
1975 models



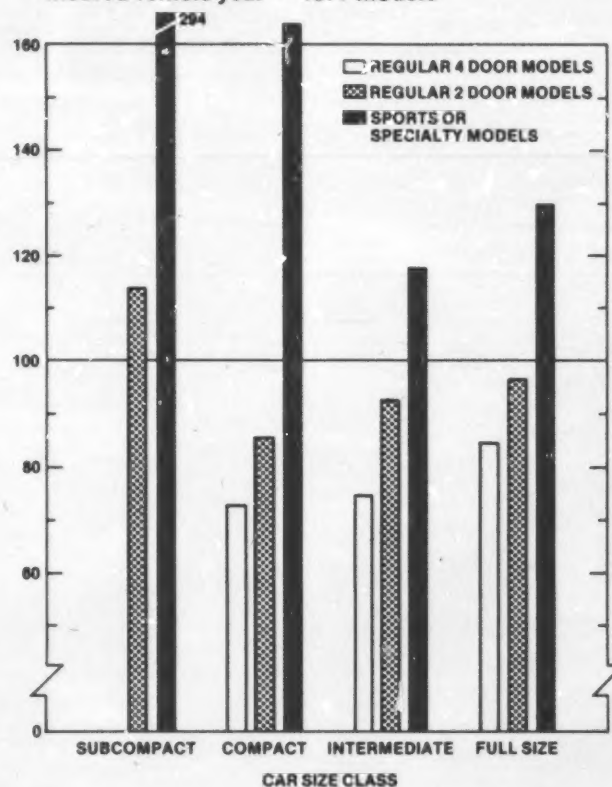
Medical payments insurance coverages
relative injury claim frequencies
1975 regular two door models



Results

employed are supplied by Aetna Life and Casualty, Allstate Insurance Company, Government Employees Insurance Company, The Home Insurance Company, Kemper Insurance and Financial Companies, Liberty Mutual Insurance Company, Nationwide Mutual Insurance Company, Prudential Property and Casualty Insurance Company, State Farm Mutual Automobile Insurance Company, the Travelers Insurance Companies, and the United Services Automobile Association.

Collision insurance coverages
relative average loss payments per
insured vehicle year — 1977 models



(Under separate cover, the Highway Loss Data Institute is publishing a detailed description of its work, "About the Highway Loss Data Institute." Copies may be obtained on request either from the Insurance Institute for Highway Safety or by writing directly to Highway Loss Data Institute, Watergate 600, Washington, D.C. 20037.)

Bibliography: 89-114

Status Report: Vol. 13, No. 3, March 2, 1978; Vol. 13, No. 1, Jan. 16, 1978; Vol. 12, No. 18, Dec. 23, 1977; Vol. 12, No. 11, June 29, 1977; Vol. 12, No. 5, March 15, 1977; Vol. 12, No. 1, Jan. 10, 1977; Vol. 11, No. 11, July 8, 1976; Vol. 11, No. 1, Jan. 12, 1976; Vol. 10, No. 14, Aug. 14, 1975

ISSUE: CARBON MONOXIDE POISONING

Problem: Each year parked cars are found with their occupants dead of carbon monoxide poisoning. What is the magnitude of the problem?

Institute Action:

More than 500 Americans may be dying each year from carbon monoxide poisoning in "vehicles that are defective due to deterioration, damage, or poor automotive design," according to an Institute-supported study. The study was carried out by researchers from Maryland medical examiners' offices and Johns Hopkins University. They found that rust was "a major factor in most cases, having caused a combination of exhaust system defects plus holes in the body. Even two-year-old cars had significant rust damage. . . . In addition to rust damage, mechanical damage to components of the exhaust system or to the body was involved in several cases." They discovered that almost half of the fatalities involved alcohol and stated that "there is also evidence of a synergistic effect of

alcohol and carbon monoxide, leading to death at lower carboxyhemoglobin saturation levels when the blood alcohol concentration is high."

Among countermeasure possibilities that should be explored, the study concluded, were:

Designing vehicles so as to "completely eliminate the production of carbon monoxide" and thus to eliminate both deliberate and inadvertent deaths caused by it.

"Better separation of exhaust fumes from the passenger compartment," such as by release of fumes in altered directions, tighter sealing of openings between trunks and passenger compartments, location of exhaust system components so they are less subject to impact and resulting rupture, and use of "less corrodible materials" to inhibit rusting of relevant structures.

Bibliography: 8

Status Report: Vol. 7, No. 9, May 3, 1972

ISSUE: COSTS, BENEFITS, EFFECTIVENESS, AND SAFETY

Problem: "Cost-benefit" and "cost-effectiveness" analyses are often misapplied and misunderstood in debates and decisions concerning present and proposed motor vehicle and other safety performance standards. (Cost-effectiveness studies compare the costs of alternative ways of meeting a particular goal, whereas cost-benefit analyses assess the net financial gain or loss to society of implementing a particular change.)

Institute Action:

☐ In a basic conceptual analysis presented before the Society of Automotive Engineers in 1974, two Institute staff members underscored the danger of misusing

such techniques to attack or justify particular motor vehicle safety standards. "Since a motor vehicle safety performance standard has no costs per se," they noted, "it cannot be evaluated either in cost-benefit or cost-effectiveness terms." It is the particular design alternatives available to manufacturers to achieve the objectives of a standard that have societal costs, the authors noted. The various design alternatives can be evaluated.

"Cost-effective designs should be chosen to minimize societal costs, and until there is evidence that cost-effective designs have been chosen, cost-benefit studies are premature," they stressed. Even then, they stressed, because of the major conceptual and methodological difficulties in the valuation of life and limb, cost-benefit studies would be appropriate *only* in the evaluation of designs not primarily intended to save lives and reduce injuries—that is, vehicle designs to reduce property damage. "Until manufacturers are forthcoming with accurate cost data, neither cost-effectiveness nor cost-benefit studies in this field can be relied upon," they concluded.

☐ An Institute-sponsored study by the Center for the Environment and Man, which examined the conceptual and practical problems arising when applying benefit-cost analysis to loss issues, explained that benefit-cost analysis "may have to be supplemented by analyses of a broader scope, and a rational choice between alternative programs may have to rely more on consideration of these less precise analyses than on that of the apparently precise results of a benefit-cost analysis. Furthermore, the goals of a society, particularly in the context of lifesaving and injury reduction, can be and often are legitimately set without resort to economic analyses formal or otherwise."

Using the guidelines established by the Institute and the Center for the Environment and Man work, future

Results

discussions of the value of proposed safety and property damage standards can be both more logical and more productive. These papers are in wide use by private and public organizations that deal with the difficult issues involved.

Bibliography: 31, 140, 192, 194

Status Report: Vol. 9, No. 20, Nov. 11, 1974; Vol. 9, No. 19, Oct. 29, 1974

ISSUE: IDENTIFYING LOSS REDUCTION OPTIONS

Problem: Traditional, often ineffective approaches to highway safety have been based largely on piecemeal, unsystematic perceptions of highway loss causes and countermeasure alternatives. What are the appropriate conceptual frameworks for practical highway loss problem solving?

Institute Action:

☐ Institute papers have developed and described the basic concepts for the control of injury to people and economic losses both in the highway environment and more generally in society. For example:

—A powerful and broadly applicable analysis of options for reducing society's losses in damaged people and property, first published in M.I.T.'s *Technology Review* in 1970, entitled "On the Escape of Tigers: An Ecologic Note," pointed out, "A major class of ecologic phenomena involves the transfer of energy in such ways and amounts and at such rapid rates, that inanimate or animate structures are damaged. The harmful interactions with people and property of hurricanes, earthquakes, projectiles, moving vehicles,

ionizing radiation, lightning, conflagrations, and the cuts and bruises of daily life illustrate this class." It then identified the ten basic strategies for reducing such losses, illustrated each with long-used loss-reduction tactics, and noted some of the considerations in choosing strategy emphasis. The analysis concluded, "It has not generally been customary for individuals and organizations that influence, or are influenced by, damage due to harmful transfers of energy to analyze systematically their options for loss reduction, the mix of strategies and tactics they might employ, and their cost. Yet, it is entirely feasible and not especially difficult to do so, although specific supporting data are still often lacking. In fact, unless such systematic analysis is done routinely and well, it is generally impossible to maximize the pay-offs both of loss-reduction planning and of resource allocations.

"Such analysis is also needed to consider properly the problems inherent in the use of given strategies in specific situations. Different strategies to accomplish the same end commonly have different requirements; in kinds and numbers of people, in material resources, in capital investments, and in public and professional education, among others. In the case of some damage-reduction problems, particular strategies may require political and legislative action more than others. And, where the potential or actual hazard exists across national boundaries, correspondingly international action is commonly essential. . . ."

—In 1975, this ten-strategy analysis was extended in "Reducing the Damage of Motor-Vehicle Use," also published in *Technology Review*. In it, the author stressed that to be successful, "the choice of loss-reduction countermeasures among the options available must be based on their effectiveness in helping to reduce the end results in damage—not necessarily on preventing the initiation of the impacts themselves. As with most contemporary problems, this requires

a mix of strategies and tactics, chosen not on the basis of their earliness in the causal sequence or because of our penchant for 'blaming the victim,' but, rather, on their contributions to reducing the social problem—the damage to people and their property."

—In "A Logical Framework for Categorizing Highway Safety Phenomena and Activity," which appeared in the *Journal of Trauma* in 1972, the author pointed out: "Road losses in energy-damaged people and property are a subset of the ancient problem of people and property damaged by energy exchanges of all types, including those involving thermal, mechanical, and other forms of energy." Past failures to analyze highway loss problems and develop countermeasures by using logical, scientifically sound approaches applied successfully to other problems of energy damage, the paper said, have consigned millions of Americans to death and hundreds of millions to non-fatal injury, and have cost the United States more than \$100,000,000,000 in needless economic losses each decade; "Highway safety is a social issue, not because vehicles crash, but because of the losses in damaged people and property. . . . It is basic to the rational reduction of highway losses that there is no present evidence that vehicle crashes can be eliminated, or even adequately reduced in numbers for the foreseeable future. Consequently, vehicle and highway crash design must anticipate such crashes and provide as nearly completely as possible, and uniformly so, for injury-free decelerations, in crashes that occur at and below the maximum speed at which they are operated."

—"Injury Control," completed in 1978 as a basic introduction for medical workers and students, and others concerned with the logic of—and approaches used in—the modern field of injury control, points out that even though injuries are "the leading cause of death for more than half the span of human life," until

recently their control has "received little attention from relevantly trained scientists. . . . Greater awareness of the professional opportunities in this neglected field could and should shift attention from lesser sources of morbidity and mortality that now receive disproportionate emphasis." The paper's authors describe the range of scientific approaches available for reducing the frequency and severity of injuries and their aftereffects.

Bibliography: 59, 63, 64, 66, 67, 69, 70, 72, 77, 88, 152, 192, 196, 218

Insurance Institute for Highway Safety

Board of Directors

**American Insurance Highway
Safety Association**



George G. P. Knapp (Chairman,
IIHS Board of Directors)*
Senior Vice President
Chubb & Son Inc.



Henry Katz
Senior Vice President and
Secretary
The Home Insurance Company



Frank E. Walton
Senior Vice President
The Travelers Insurance Company



T. Lawrence Jones
President
American Insurance Highway
Safety Association
ex-officio

**American Insurers Highway
Safety Alliance**



Roger H. Wingate*
Senior Vice President
Liberty Mutual Insurance
Company



G. L. Maatman
Vice President and Director
Corporate Planning & Research
Kemper Insurance & Financial
Companies



Donald E. Reutershan
President
Sentry Insurance, A Mutual
Company



Paul S. Wise
President
American Insurers Highway Safety
Alliance
ex-officio

**National Association of Independent
Insurers Safety Association**



Charles A. Weeber*
Vice President, Claims Counsel
United Services Automobile
Association



Donald L. Schaffer
Senior Vice President, Secretary
and General Counsel
Allstate Insurance Company

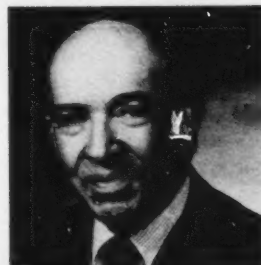


W. V. Siegfried
Vice President—Underwriting
Nationwide Mutual Insurance
Company



Arthur C. Mertz
President
National Association of
Independent Insurers Safety
Association
ex-officio

Associate Members



Martin Albaum*
Director of Research
Prudential Property and Casualty
Insurance Company



Donald P. McHugh
Vice President and General
Counsel
State Farm Mutual Automobile
Insurance Company



John E. Riley
Vice President—Personal Lines
Safeco Insurance Companies

**Delegation chairmen.*

Staff

For organization purposes, staff members work in several Institute departments. They work, on a project-by-project basis, with staff members from other departments as well as their own.

Research department members are principally responsible for designing, carrying out, and monitoring scientific inquiries into highway loss problems and countermeasures.

The *operations* staff conducts demonstration projects that translate loss reduction knowledge into real-world countermeasure programs. In addition, it manages the Institute's crash-testing programs.

The *communications* staff makes Institute research findings and conclusions available to the public, insurers, auto manufacturers, and government through print media, television, radio, films, special presentations, and Institute publications.

The office manager's staff carries out internal support activities for the Institute including library, personnel, printing, supply, and related functions.

The *executive* office provides policy direction and coordinates and oversees the work of the Institute.



including publishing and legal firms.

Judy Ali, secretary to the general counsel, came to the Institute in March 1973. Before that she worked as a secretary and administrative assistant for a variety of organizations in the Washington area,



Law. His past legal experience included extensive research and writing for a Washington law firm.

John Arminio is legal assistant to the Institute's general counsel. He received a bachelor of arts degree from Georgetown University and his juris doctor degree from the Catholic University School of



cles. Before joining the staff in September 1968, she was a secretary at the Home Insurance Company and special assistant at the White Marsh Elementary School in St. Mary's County, Maryland. Batchelor attended Temple Business School and holds an honor certificate from the Washington School for Secretaries and an associate degree from the Patricia Stevens College.



tute's computerized bibliography and stockroom publication listings, maintains special files on federal rulemaking for motor vehicles, and coordinates preparation of all art work and projection slides. She has taken advanced courses at George Washington University and is presently studying printing, layout, and design at the U.S. Department of Agriculture Graduate School.

Cheryl Batchelor is secretary to the editor in the communications department. She maintains detailed reference files of the Institute's publication, *Status Report*, and a special file of Institute news arti-

Mary Ann Braunstein joined the Institute in April 1971. She is assistant office manager and records coordinator. In addition to her duties as assistant office manager, Braunstein maintains the Insti-



struction firm. She received a B.A. in creative writing and English from Bowling Green University in Ohio.

Sharon Brokaw, secretary to the assistant office manager and records coordinator, joined the Institute in 1977. Her previous experience included duties as secretary to the vice president of a con-



from the National Cancer Institute before joining the Institute in 1977. At the Institute, Burchman is involved in data analysis and computer programming.

Phyllis Burchman is a member of the research department. After graduating from the University of Maryland with a degree in zoology, Burchman worked as a biomedical data analyst under grants



Carolyn Carter is executive secretary to the office manager. She joined the Institute in March 1974. Her past employment included work in the fields of insurance, engineering, and law. Carter is

currently taking courses in business administration at Northern Virginia Community College.



Debbie Davison assists in coordinating film services and manages the Institute's film library. She joined the staff in 1976. She received a degree in political science from Wittenberg University,

and took business training at the Stafford Hall School of Business in New Jersey.



Patti Diener is the publications secretary in the communications department. She previously conducted legislative research for a political consulting group and worked in several political cam-

paigns. Diener holds a B.A. in history from Carnegie-Mellon University in 1977.



Cathy Freeman, a secretary in the research department, handles most of the preparation of the Institute's manuscripts and testimony. Previous to her joining the Institute in 1976 she worked as an execu-

tive secretary with two Atlanta businesses. She received her B.A. degree from Mercer University in English and elementary education.



Kathy Funk is clerk-typist for the Institute library. She attended Virginia Commonwealth University before joining the Institute staff in 1978. Her previous experience included employ-

ment at the CIA and the Literature Research Company.



Marvin Ginsburg, computer specialist on the research staff, joined the Institute in September 1971 after 10 years in government and industry. Ginsburg was graduated from the University of Texas

with a degree in mathematics and has completed several years of graduate study in mathematics. He is experienced in computer systems, project management, systems planning and implementation, and marketing support. He manages the data processing function for the Institute. He has been involved in such diverse activities as research on passive restraints, the effects of speed limits, relationships between car size and occupant death rates, and developing an in-house mailing list system.



Sherry Goins, records coordination assistant, was an abstractor/indexer for the Logical Technical Services Corp. where she worked on the National Highway Traffic Safety Administration's

safety literature project before joining the Institute in 1977. She also has had library experience. She received a B.A. in history from George Mason University.



William Haddon, Jr., M.D., became president of IIHS in March 1969. Previously he was the first Director of the National Highway Safety Bureau (now the National Highway Traffic Safety Administration), a

position he held from his appointment by President Johnson in the fall of 1966, with the approval of the Senate, until his resignation in 1969. As its first head, Haddon built the agency and the extensive range of programs called for by the Congress in the two safety acts of 1966. This included the development of the national standards for state and community highway safety programs, as well as the more well-known, initial standards for motor vehicles and their equipment. A physician with degrees from the Massachusetts Institute of Technology, Harvard Medical School, and the Harvard School of Public Health, Haddon is an authority on the ecology of environmental hazards and on public and private measures to reduce the damage to people and property associated with them. Prior to his service with the federal government, Haddon was with the New York State Department of Health for ten years. During this period he earned a reputation as a thorough researcher and advocate of analytical methods in dealing with highway losses. He established special credentials in investigating the relationship of alcohol to fatal highway crashes; subsequently, during his federal service, he was senior author of the 1968 *Alcohol and Highway Safety Report* submitted by the Department of Transporta-

tion to the Congress. He also was principal author of *Accident Research: Methods and Approaches* (Harper & Row, 1964), one of the basic works in the field of loss reduction. His scientific publications, predominantly dealing with public health, have been extensive. Haddon has been the recipient of numerous awards, including the American Trauma Society's 1977 *Stone Award*, the American Public Health Association's 1969 *Bronfman Prize for Public Health Achievement* and the 1969 *MODERN MEDICINE Distinguished Achievement Award*, "... in recognition of outstanding contributions to the progress of medicine as exemplified by his trailblazing scientific research in causes of traffic trauma and administrative efforts to promote highway safety."



Chris Herlihy is the film coordinator with the communications staff. Herlihy has had extensive media experience, including positions as assistant to John Chancellor at NBC

News, writer-producer for WRC-TV in Washington, and executive news producer at WJZ-TV in Baltimore. She won first place in a 1977 news-writing contest sponsored by the Maryland-Delaware-D.C. Press Association while working for the *Havre de Grace, Md., Record*. Her duties at the Institute include film production and writing for *Status Report*. She received a B.A. in political science from Manhattanville College.



Elizabeth W. Hill is the office manager of the Institute. Her administrative duties include the supervision of purchasing, personnel functions, records coordination, the library, printing and

production, reception and switchboard, mail, and office security and maintenance. Before coming to the Institute in June 1973, she was general program coordinator for the National Reading Center Foundation, and had long been executive secretary to the superintendent of schools in Shaker Heights, Ohio. Hill attended Mary Washington College of the University of Virginia.



Paul C. Hood is editor of publications in the communications staff. He joined the Institute in July 1977 after 16 years with the *National Observer*, where he had served as a member of the original plan-

ning staff, senior editor in charge of editorial production, and staff writer in consumer, automotive, and energy fields. Previously he had worked as a daily newspaper editor and reporter in Oklahoma, Missouri, and Illinois. Hood was graduated from the University of Missouri, where he received a degree from the School of Journalism.



Daryl Hornby, executive secretary to the vice-president for operations, has had various public relations experience. She attended the University of Denver and is continuing her education at Northern

Virginia Business School.



Andrew R. Hricko, general counsel and secretary-treasurer, is responsible for the fiscal and personnel policies at the Institute. In addition, he supervises and advises on the Institute's growing

research into legal matters as they affect highway loss reduction. Hricko acts as Institute liaison with the legal staffs of trade associations, the Federation of Insurance Counsel, and public service and other groups interested in the work of the Institute. He has published several articles on highway safety and on alcohol and air safety. Before joining the staff in July 1964, he served as a senior attorney with the Board of Governors of the Federal Reserve System and as an assistant attorney general for Pennsylvania. He holds a B.S. degree from the University of Scranton and a J.D. degree from the Dickinson School of Law.



Bari Johnson is the administrative secretary in the research department. Before joining the Institute in 1976, she was office manager in a Connecticut business, administrative assistant with the Urban

Institute Land Use Center, and executive secretary to two corporations. She received her bachelor's degree in elementary education from Old Dominion University in Virginia.



Benjamin Kelley is senior vice president of IIHS. He came to the Institute in March 1969. In addition to overall Institute management responsibilities, he directs the Institute's communications pro-

gram, which makes Institute research findings and conclusions available to the public, insurers, and government through print media, television, radio, films, special presentations, and Institute publications. Kelley is author of articles, papers, and films on issues involving highway loss problems, national transportation policy, and the communications field, and he frequently speaks on these subjects. Among his films are the award-winning productions, "Boobytrap!" and "... In the Crash." Kelley's articles have appeared in

numerous national publications, including *Nation*, *World* (now *Saturday Review*), *Current*, and *Lithopinion*. He also is the author of the book, *The Pavers and the Paved: The Real Cost of America's Highway Program* (Donald W. Brown, Inc. 1971). Before joining the Institute, Kelley was director of the Office of Public Affairs in the U. S. Department of Transportation's Federal Highway Administration. While there he was a co-author, with Dr. Haddon, of the U. S. Department of Transportation's 1968 *Alcohol and Highway Safety Report to Congress*. Prior to that, Kelley held senior management positions with the U. S. Chamber of Commerce and the Interstate Commerce Commission. His experience also includes editorial posts with the *Journal of Commerce*, *Traffic World Magazine*, and *Japan Shipping and Trade News*. Kelley attended Sophia University and has received language diplomas from the Monterey Language School and the Naganuma Institute.



Brenda Laws is executive secretary to the senior vice president. As such she is coordinator of support staff in the communications department. She has extensive secretarial and managerial experi-

ence including a position as executive secretary to the State of New Mexico Energy Resources Board. She received a bachelor's degree in business education from Tennessee Technological University.



Betty Lawton is the Institute librarian. She is responsible for obtaining all resource materials and periodicals and operating a loan and reference library to serve the Institute staff. She received an A.B. in

languages from Douglass College in New Jersey and a M.L.S. from the University of Maryland, and was previously employed as the reference librarian in the Montgomery County, Maryland, library system.



Robin McManus performs duties as assistant for the printing and production of Institute publications and coordination of the mail list. Prior to joining the Institute in 1977, she was involved in the

production of a Congressional news service and wrote legislative newsletters for District of Columbia trade associations. She attended Manhattanville College and the University of Pittsburgh.



A. Eugene Miller, vice president for operations, is responsible for the Institute's operations and demonstration projects and crash test programs, and has been the liaison with state safety

councils and national organizations. Projects he has been responsible for include development and publication of *The Law and Roadside Hazards* and *Role of Police in Roadside Hazard Modification and Reporting*. Miller has also supervised the development of the TAGS program—a real-time vehicle identification system designed to aid the police. In addition to low-speed crash test programs, Miller has managed the Institute's crash tests in support of the films "Crashes That Need Not Kill" and "Cars That Crash And Burn," as well as the Institute's work on truck underride crashes. Before coming to the Institute in March 1972, Miller spent over 20 years in the computer and communications field. His work included broad experience in design and implementation of large, complex systems, including management and technical involvement in the development of the Department of Defense's worldwide Automatic Digital Network, the first major communications system to employ electronic computers for routing and relaying data. He holds bachelor's and master's degrees in mathematics and philosophy from the University of Pennsylvania.



Karen Miller is a member of the research department. She joined the Institute in January 1975 after graduating from the University of Colorado with a degree in biology. She has been involved in the

preparation, processing, and analysis of data concerned with child restraint use, air bags, and lap and shoulder belts.



Dinesh Mohan, a bioengineer, is a member of the research staff. He joined the Institute in 1976 after four years with the Highway Safety Research Institute in Michigan as a research assistant and

engineer. Dr. Mohan received his Ph.D. in bioengineering from the University of Michigan at Ann Arbor. At the Institute he has been involved in the evaluation of the effectiveness of air bags and lap and shoulder belts in preventing injuries in automobile crashes, and also has done research on biomechanics of head-impact injuries to children.



Brian O'Neill, vice president for research, came to the Institute in December 1969 after having gained a wide range of experience in applied mathematics and statistical research.

O'Neill received a degree in mathematics and statistics from the Bath University of Technology in England. He has worked in England and the United States in a variety of research and consulting capacities. O'Neill has worked as a contractor to the National Aeronautics and Space Administration, where he was involved in determining the accuracy and precision of experimental laser satellite tracking systems. He also worked on satellite orbit determination and studies of the earth's shape and gravity field using satellite observations. At the Institute, he directs and monitors the research activities. His own areas of investigation have included the evaluation of breath-alcohol testing devices, the effectiveness of auto head restraints, development of statistical distributions that describe insurance losses, the development of an injury scoring system to measure the overall severity of multiple injuries, studies of pedestrian crashes, the relationships between car weight and car size and crash injuries, comparative evaluations of active and passive restraints, assessments of cost benefit and cost-effectiveness analyses, and comparisons of alternate methods for restraining child car occupants.



Charles Pace is the Institute's mail and stock clerk. Prior to coming to the Institute, he was a music teacher in the District of Columbia public schools. He received a B.S. in music education from Knoxville

College. Currently he is continuing graduate studies in education at George Washington University.



Carole Prudden is a clerk-typist and receptionist in the department of office management. After graduating from Wittenberg University in 1976 with a bachelor's degree in history, Prudden was a

youth organizer for the Lutheran Church in America in upstate New York. She also has served as a counselor for youths and homeless women.



John P. Reichard is a writer on the communications staff. Prior to joining the Institute in 1978 he was working in a master's program in journalism at the University of Maryland. He has written

for a suburban newspaper in the Washington, D.C., area and was co-editor of a newsletter for the National Archives labor union.



Leon S. Robertson is the Institute's senior behavioral scientist. He joined the research staff in July 1970. After receiving his doctorate in sociology from the University of Tennessee, he taught at Wake

Forest University, received a postdoctoral fellowship for work at The Johns Hopkins University from the U. S. Public Health Service, and was a research associate at Harvard Medical School and Children's Hospital Medical Center in Boston. Before coming to the Institute, Robertson was assistant professor at Harvard Medical School. His research has included studies in stress, the delivery of medical care, and loss reduction. Robertson is the co-author of *Biology and Social Behavior* (The Free Press, 1972), *Changing the Medical Care System* (Praeger, 1974), and *Medical Sociology*:

A General Systems Approach (Nelson-Hall Co., 1975). At the Institute, he has worked on a wide variety of studies dealing with factors affecting safety belt use. He has also conducted studies of alcohol countermeasures, driver education, motorcyclist helmet laws, motor vehicle safety standards, roadside hazards, and vehicle size.



Diane Schwartz is the Institute's printing production coordinator. In addition she maintains the extensive mail list. Schwartz joined the Institute in May 1973 after attending Anne Arundel Commu-

nity College. She is currently continuing her education at the University of Maryland.



Sue Scott is a secretary in the research department. Scott has had extensive secretarial experience, including work with the Stanford Research Institute. She was graduated from the Krissler Business

Institute in 1965 with an associate degree.



Lynne Smith, senior coordinator in the communications department, develops special projects, writes for *Status Report*, and edits *Results Report*. She was formerly with the Center for Auto Safety as di-

rector of the Center's Highway Project, where she co-authored a study of design hazards in the federal-aid highway program. Previously she headed the research department at Public Communications, Inc., the first public-interest law/consumer advertising firm. Smith received a B.A. in English literature from Mills College in California.



Glen Stueve is the Institute accountant. As such he handles all the internal financial affairs of the Institute. Stueve holds a bachelor's degree in commercial science from Benjamin Franklin Uni-

versity in Washington. He joined the Institute in April 1969 after working for several years in commercial firms in managerial accounting positions.



Carolee Tomlinson is executive secretary to the president. Formerly an administrative secretary with the A.B. Dick Co. in Illinois, she received her B.S. in business administration from Indiana University.



Rea Tyler, a writer with the communications staff, came to the Institute in 1978 after serving as editor and assistant executive director for the Physicians National Housestaff Association. Prior

to that she had been a court reporter and for several years was a program director for the Georgetown University Alumni Association. After attending the Lutheran Hospital School of Nursing in Baltimore, she studied public administration at George Mason University in Virginia. She is continuing her education at American University in Washington.



Karen Weinberg is the Institute receptionist. Prior to joining the Institute in 1978, Weinberg worked as a speech therapist, a substitute teacher, and in retail sales. She received her B.S. in speech pathology and audiology from West Virginia University.



JoAnn Wells is a member of the research staff. Prior to joining the Institute in 1975, Wells did statistical evaluation work in private industry. She has been involved in the analysis of data for many research projects and is also responsible for much of the computer programming at the Institute. Wells was graduated from Emmanuel College in Boston with a degree in economics and later did postgraduate work at the University of California at Berkeley.



Allan Williams is a social psychologist who joined the research department in October 1972. He was formerly project director at The Medical Foundation, Inc., in Boston and a research analyst with the Massachusetts Department of Public Health Division of Alcoholism. Williams received his A.B. in psychology from Wesleyan University and his M.A. and Ph.D. in social psychology from Harvard. He has authored numerous research papers on alcohol use, preventive health behaviors, and other topics. At the Institute his research has included studies on bicycle-motor vehicle collisions, the federal government's fatal crash reduction program, and the effect of lowered legal drinking age on crashes. He also has conducted several studies on factors related to crash injuries to children in cars, such as seating positions and use of child restraints, and evaluated programs designed to influence parents to protect their children against crash injuries.

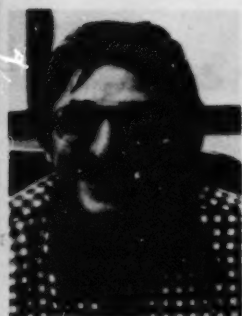


Jackson Wong is senior automotive engineer in the research department. Prior to coming to the Institute in March 1970 he was involved in advanced aerospace technology research with several

organizations, including Boeing, Bell Aerospace, and Atlantic Research. Wong received his master's degree in mechanical and automotive engineering from Oregon State College. He has been involved in most of the Institute's crash-testing programs, and has worked on the problems of roadside hazards and the development of breakaway utility poles, truck underride guards, low cost crash recorders, damage resistant bumpers, and automotive defect studies.



Paul Zador joined the research staff in April 1972 as a statistician after extensive experience in applied statistics, and statistical and mathematical research. Zador received his initial degree and did graduate work at Oxford University, and received his Ph.D. in mathematical statistics from Stanford. His research activities at the Institute include the analysis of the effectiveness of the federal government's alcohol safety action programs, comparisons of the effectiveness of air bags and seat belts, and study of the effectiveness of driver education programs. He also provides general statistical and mathematical support for the research department.



Loren Zarembo joined the research staff as a physicist in June 1975. He was previously standards consultant with the U.S. Department of Health, Education, and Welfare. Zarembo received his

doctorate in nuclear physics from the University of Maryland and his undergraduate degree from the University of Michigan. His research activities at the Institute have included studies of the effects of the 55-mile-per-hour speed limit on rear-end collisions involving cars and trucks, the development of devices to prevent cars from underriding trucks, and studies of the effects of car size and structural characteristics on occupant injury.

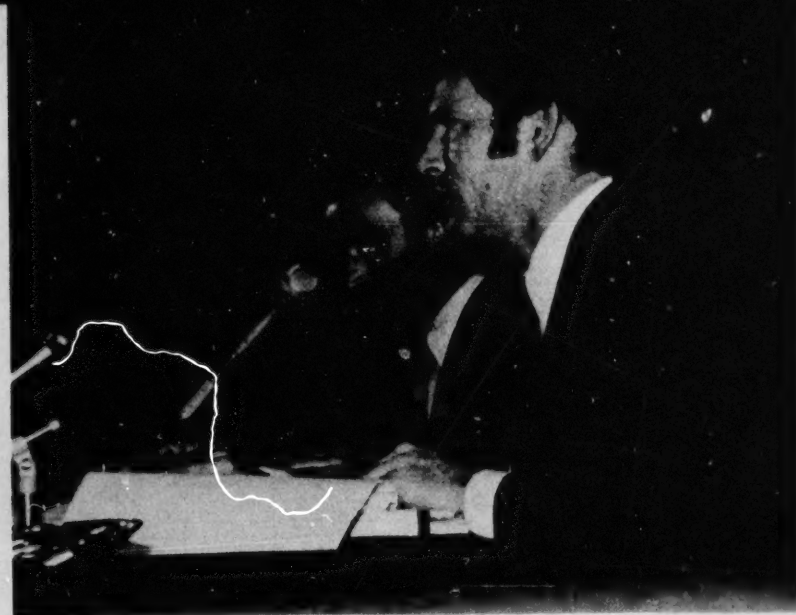
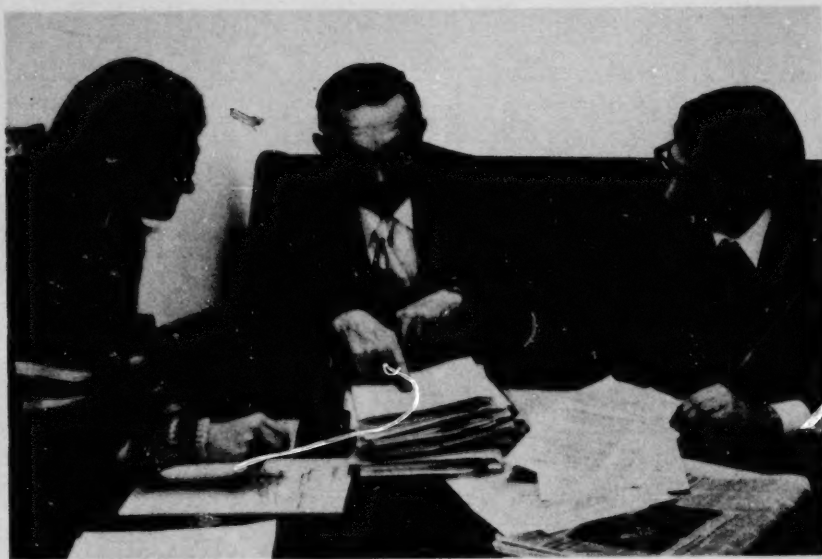


Judith Zimmerman, a transportation engineer, joined the staff in 1977. She was formerly with the Highway Safety Research Institute at the University of Michigan, as well as having worked

for Exxon. Zimmerman received her bachelor degree in civil engineering from Georgia Institute of Technology and her master of science in civil engineering from the University of Michigan.



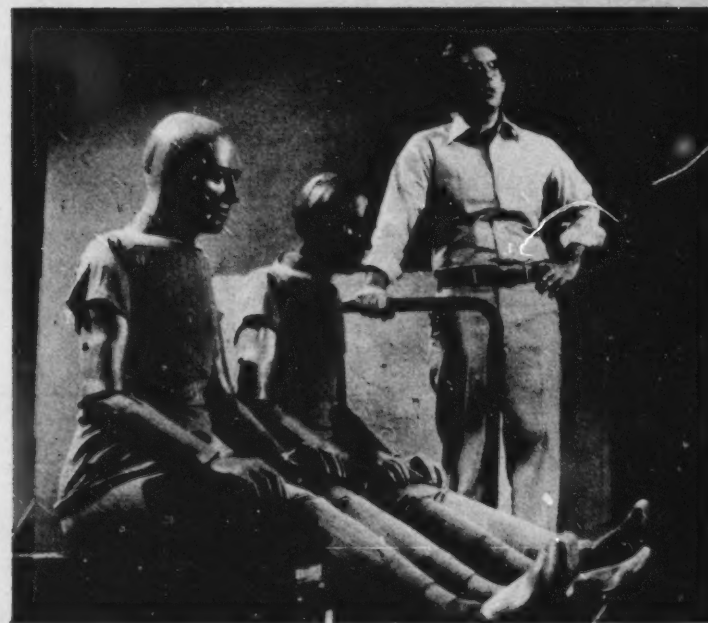
Pat Zolenski is the Institute's accounting clerk. Prior to her work with the Institute she was the secretary-treasurer of a Virginia business. She is currently working toward a degree in business administration.



Films

79

The Institute's films are available for *free loan and TV use* from Association Films, Inc., 1815 North Fort Myer Drive, Arlington, Virginia 22209. (Please allow a minimum of four to six weeks for processing requests.) Films may be *purchased* from Harvest Films, Inc., 309 Fifth Avenue, New York, New York 10016.
212-684-7950.



134



35

Underride points out, using both Institute research film and real-world examples, the urgent need for federal and state governments to establish a tough underride protection standard to reduce the needless loss of life and the serious injury that can result when cars run into and under the rear ends of trucks. Producers, Leo Trachtenberg and Christine Herlihy; director, Leo Trachtenberg; written by Christine Herlihy; narrator and production adviser, Benjamin Kelley; editor and animation supervisor, Paul Swedenburg. 16mm, color, sound, 14 minutes. New York: Harvest Films, Inc., 1978.

Crashes That Need Not Kill looks in depth at restraint systems in automobiles, especially automatic ("passive") air bags and "active" safety belts. Producer, Leo Trachtenberg; directors, Leo Trachtenberg and Benjamin Kelley; written and narrated by Benjamin Kelley. 16mm, color, sound, 28 minutes. (Awarded the Council on International Non-theatrical Events Golden Eagle, 1976. Recipient of the Bronze Venus at the Virgin Islands' International Film Festival, 1976.) New York: Harvest Films, Inc., 1976.

Cars That Crash and Burn focused public and government attention on the vulnerability of fuel systems in moderate speed rear-end crashes. Director-producer, Leo Trachtenberg; originated, written, and narrated by Benjamin Kelley. 16mm, color, sound, 27 minutes. New York: Harvest Films, Inc., 1973.

Small Cars & Crashes, noting that emphasis on fuel economy may mean more small cars on the road, shows the greater risk of injury to the occupants when their small cars collide with larger ones. Director, Leo Trachtenberg; producers, Leo Trachtenberg and Roger P. Reidy; writers, Richard Hébert and Benjamin Kelley; originated and narrated by Benjamin Kelley. 16mm, color, sound, 23 minutes. New York: Harvest Films, Inc., 1972.

Boobytrap! focuses attention on the national problem of roadside hazards, such as rigid lightpoles, blunt-end guardrails, and bridge abutments that commonly turn otherwise minor, run-off-the-road incidents into

major injury-producing crashes. The film also points up the practical long-available solutions to the problem. Director-producer, Leo Trachtenberg; writers, Benjamin Kelley and Richard Hébert; originated and narrated by Benjamin Kelley. 16mm, color, sound, 28 minutes. (Awarded the Council on International Non-theatrical Events Golden Eagle, 1973. Official U.S. entry Zagreb International Festival of Traffic Safety Films. Recipient of First Prize, U.S. National Committee on Films for Safety, 1973.) New York: Harvest Films, Inc., 1972.

... *In the Crash* took a comprehensive look at what happens to people in car crashes, and how the redesign of cars and highways can prevent many of the needless deaths and injuries on the nation's highways. Director-producer, Leo Trachtenberg; writers, Benjamin Kelley and Richard Hébert; originated and narrated by Benjamin Kelley. 16mm, color, sound, 22 minutes. (Awarded the Council on International Non-theatrical Events Golden Eagle, 1971. Official U.S. entry, Zagreb International Festival of Traffic Safety Films, awarded First Prize.) New York: Harvest Films, Inc., 1970.

Low Speed Crash Tests Series. This series of films, begun in 1969, contains results of the Institute's low-speed impact test program. Director-producer, Leo Trachtenberg. New York: Harvest Films, Inc. The individual films are:

- 1969 Low Speed Crash Tests
- 1970 Low Speed Crash Tests
- 1971 Low Speed Crash Tests
- 1972 Low Speed Crash Tests
- 1973 Foreign Low Speed Crash Tests
- 1973 Domestic Low Speed Crash Tests
- 1974 Foreign Low Speed Crash Tests
- 1974 Domestic Low Speed Crash Tests
- 1975 Model Pendulum and Barrier Tests
- Comparative Bumper and Performance:
Crash Tests of 1972, 1974, and 1975
- 1976 Low Speed Crash Tests
- 1977 Low Speed Crash Tests
- 1978 Low Speed Crash Tests

Selected Bibliography

The following publications in the field of loss reduction were supported in whole or in part by the Institute. The authors are members of the Institute staff, independent researchers, or a combination of both. This body of work reflects activities of the Institute from January 1969 through Spring 1978.

1. Ashton, S. J.; Pedder, J. B. and Mackay, G. M. *Influence of Vehicle Design on Pedestrian Leg Injuries*. Washington: Insurance Institute for Highway Safety, April 1978.
2. Baker, Susan P.; Gertner, Harold R.; Rutherford, Robert B. and Spitz, Werner U. "Traffic Deaths Due to Blunt Abdominal Injuries." *Proceedings of the Fourteenth Annual Conference of the American Association for Automotive Medicine*, Nov. 19-20, 1970, pp. 67-75. Ann Arbor: University of Michigan, 1971.
3. Baker, Susan P.; Robertson, Leon S. and Spitz, Werner U. "Tattoos, Alcohol and Violent Death." *Journal of Forensic Sciences*, Vol. 16, No. 2 (April 1971), pp. 219-225.
4. Baker, Susan P. "Digit Preference in Reported Time of Collision." *Accident Analysis and Prevention*, Vol. 3, No. 1 (July 1971), pp. 77-80.
5. Baker, Susan P. "Evaluation of Medical Care of the Injured." An Editorial in *The Journal of Trauma*, Vol. 11, No. 10 (October 1971), pp. 892-894.
6. Baker, Susan P. "Injury Control: Accident Prevention and Other Approaches to Reduction of Injury." In *Preventive Medicine and Public Health*, edited by Philip E. Sartwell, pp. 987-1005, 10th ed., New York: Appleton-Century-Crofts, 1972.
7. Baker, Susan P.; Robertson, Leon S. and O'Neill, Brian. "Drivers Involved in Fatal Pedestrian Collisions." *Proceedings of the Sixteenth Conference of the American Association for Automotive Medicine*, Oct. 19-21, 1972, pp. 115-123. Warrendale, Pa.: Society of Automotive Engineers, 1973.
8. Baker, Susan P.; Fisher, Russell S.; Masemore, William C. and Sojher, Irvin M. "Fatal Unintentional Carbon Monoxide Poisoning in Motor Vehicles." *American Journal of Public Health*, Vol. 62, No. 2 (November 1972), pp. 1463-1467.
9. Baker, Susan P. and Haddon, William, Jr. "Epidemiologia de los Accidents." *Tribuna Medica-Revisión* (Madrid), Vol. 5, No. 26 (May 1974), pp. 3-12.
10. Baker, Susan P.; O'Neill, Brian; Haddon, William, Jr. and Long, William B. "The Injury Severity Score: A Method for Describing Patients with Multiple Injuries and Evaluating Emergency Care." *The Journal of Trauma*, Vol. 14, No. 3 (March 1974), pp. 187-196.
11. Baker, Susan P.; Robertson, Leon S. and O'Neill, Brian. "Fatal Pedestrian Collisions: Driver Negligence." *American Journal of Public Health*, Vol. 64, No. 4 (April 1974), pp. 318-325.
12. Baker, Susan P.; O'Neill, Brian; Haddon, William, Jr. and Long, William B. "The Injury Severity Score: Development and Potential Usefulness." *Proceedings of the Eighteenth Conference of the American Association for Automotive Medicine*, Toronto, Sept. 12-14, 1974, pp. 58-74. Lake Bluff, Ill.: American Association for Automotive Medicine, 1974.
13. Baker, Susan P. and Haddon, William, Jr. "Reducing Injuries and Their Results: The Scientific Approach." *Milbank Memorial Fund Quarterly*, Vol. 52, No. 4 (Fall 1974), pp. 377-389.
14. Baker, Susan P. and Schultz, Richard Carlton. "Recurrent Problems in Emergency Room Management of Maxillo-facial Injuries." *Clinics in Plastic Surgery*, Vol. 2, No. 1 (January 1975), pp. 65-71.
15. Baker, Susan P. "The Man in the Street: A Tale of Two Cities." (Pedestrian Fatalities) *Johns Hopkins Magazine*, Vol. 26, No. 1 (January 1975), pp. 4-6.
16. Baker, Susan P. "Determinants of Injury and Opportunities for Intervention." *American Journal of Epidemiology*, Vol. 101, No. 2 (February 1975), pp. 98-102.
17. Baker, Susan P. and Robertson, Leon S. "How Drivers Prevented from Driving Would Reach Work: Implications for Penalties." *Accident Analysis and Prevention*, Vol. 7, No. 1 (May 1975), pp. 45-48.
18. Baker, Susan P.; Wong, Jackson and Masemore, William C. "Fatal Tractor-Trailer Crashes: Considerations in Setting Relevant Standards." *Proceedings of the Fourth International Congress on Automotive Safety*, July 14-16, 1975, pp. 25-36. Washington: U.S. Government Printing Office, 1975. Reprinted in *Annual Report—1975, National Highway Safety Advisory Committee*. Washington: U.S. Department of Transportation, April 1976.
19. Baker, Susan P. "Alcohol in Fatal Tractor Trailer Crashes." *Proceedings of the Nineteenth Conference of the American Association for Automotive Medicine*, Nov. 20-22, 1975, pp. 234-243. Lake Bluff, Ill.: American Association for Automotive Medicine, 1975.

20. **Baker, Susan P. and O'Neill, Brian.** "The Injury Severity Score: An Update." *Journal of Trauma*, Vol. 16, No. 11 (1976), pp. 882-885.
21. **Baker, Susan P.; Wong, Jackson and Baron, Robert D.** "Professional Drivers: Protection Needed for a High-Risk Occupation." *American Journal of Public Health*, Vol. 66, No. 7 (July 1976), pp. 649-654.
22. **Baker, Susan P.** "Motorcyclists, Pedestrians, and Alcohol." Presented at the Seventh International Conference on Alcohol, Drugs and Traffic Safety, Jan. 24-28, 1977. Baltimore: The Johns Hopkins School of Hygiene and Public Health, January 1977.
23. **Baker, Susan P. and Fisher, Russell S.** "Alcohol and Motorcycle Fatalities." *American Journal of Public Health*, Vol. 67, No. 3 (March 1977), pp. 246-249.
24. **Baker, Susan P. and Haddon, William, Jr.** *Ownership of Motor Vehicles in Which People Are Injured*. Washington: Insurance Institute for Highway Safety, March 1978.
25. **Bowman, Bruce M. and Robbins, D. H.** "Parameter Study of Biomechanical Quantities in Analytical Neck Models." SAE Paper No. 720957. *Proceedings of the Sixteenth Stapp Car Crash Conference*. Nov. 8-10, 1972, pp. 14-44. Warrendale, Pa.: Society of Automotive Engineers, 1972.
26. **Bowman, Bruce; Foust, David and Schneider, Lawrence.** "Simulated Occupant Response to Side-Impact Collisions." SAE Paper No. 751155. *Proceedings of the Nineteenth Stapp Car Crash Conference*, Nov. 17-19, 1975, pp. 429-454. Warrendale, Pa.: Society of Automotive Engineers, 1975.
27. **Campbell, B. J. and Reinfurt, Donald W.** *Relationship Between Driver Crash Injury and Passenger Car Weight*. Chapel Hill: Highway Safety Research Center, University of North Carolina, November 1973.
28. **Campbell, B. J.; O'Neill, Brian and Tingley, Beth.** "Comparative Injuries to Belted and Unbelted Drivers of Subcompact, Compact, Intermediate, and Standard Cars." *Proceedings of the Third International Congress on Automotive Safety*, July 15-17, 1974, pp. 12-1—12-9. Washington: Department of Transportation, 1975.
29. **Campbell, B. J.** *Driver Injury in Automobile Accidents Involving Certain Car Models: An Update*. Chapel Hill: Highway Safety Research Center, University of North Carolina, August 1974.
30. **Casassa, James II; O'Neill, Brian; Miller, Irwin and Stone, Sandra.** *A Survey of Unrepaired Automobile Crash Damage: I. 1968-1972 Models*. Washington: Insurance Institute for Highway Safety, September 1973.
31. **Casassa, James II; Sorenson, Wayne W.; O'Neill, Brian and Stone, Sandra.** *Unrepaired Crash Damage—Implications for Cost-Benefit Analysis*. SAE Paper No. 750009. Presented at the Automotive Engineering Congress, Feb. 24-28, 1975. Warrendale, Pa.: Society of Automotive Engineers, 1975.
32. **Champion, Howard; Baker, Susan P.; Benner, Carol; Fisher, Russell; Caplan, Yale H.; Long, William B.; Cowley, R. Adams and Gil, William.** "Alcohol Intoxication and Serum Osmolality." *Lancet*, Vol. 1, No. 7922 (June 28, 1975), pp. 1402-1404.
33. **Council, Forrest M. and Hunter, William W.** *Seat Belt Usage and Benefits in North Carolina Accidents*. Chapel Hill: Highway Safety Research Center, University of North Carolina, July 1974.
34. **Dotson, Louis E.; Robertson, Leon S. and Tuchfeld, Barry.** "Plasma Alcohol, Smoking, Hormone Concentrations and Self-Reported Aggression: A Study in a Social Drinking Situation." *Journal of Studies on Alcohol*, Vol. 36, No. 5 (May 1975), pp. 578-586.
35. **Drysdale, Walter F.; Kraus, Jess F.; Franti, Charles E. and Riggins, Richard S.** "Injury Patterns in Motorcycle Collisions." *The Journal of Trauma*, Vol. 15, No. 2 (February 1975), pp. 99-115.
36. **Dubowski, Kurt M.** "Biological Aspects of Breath-Alcohol Analysis." *Clinical Chemistry*, Vol. 20, No. 2 (February 1974), pp. 294-299.
37. **Dubowski, Kurt M.** "Breath Analysis as a Technique in Clinical Chemistry." *Clinical Chemistry*, Vol. 20, No. 8 (August 1974), pp. 966-972.
38. **Dubowski, Kurt M.** "Studies in Breath-Alcohol Analysis: Biological Factors," *Z. Rechtsmedizin*, Vol. 76 (1975), pp. 93-117.
39. **Dubowski, Kurt M.** "Method for Alcohol Determination in Biological Liquids by Sensing with a Solid-State Detector." *Clinical Chemistry*, Vol. 22, No. 6 (1976), pp. 863-867.
40. **Dubowski, Kurt M.** "Collection and Later Analysis of Breath-Alcohol after Calcium Sulfate Sorption" (Letter to

- the Editor), *Clinical Chemistry*, Vol. 23, No. 7, (1977), pp. 1372-1373.
41. **Fitzpatrick, James F.; Sohn, Michael N.; Silfen, Thomas E. and Wood, Robert H.** *The Law and Roadside Hazards*. Charlottesville, Va.: Michie, 1974.
 42. **Foldvary, L. A. and Lane, J. C.** "The Effectiveness of Compulsory Wearing of Seat-Belts in Casualty Reduction." *Accident Analysis and Prevention*, Vol. 6, No. 1 (September 1974), pp. 59-81.
 43. **Foldvary, L. A. and Lane J. C.** "Seat Belts for Victoria" (Letter). *The Medical Journal of Australia*, Vol. 1, No. 20 (May 13, 1972); pp. 1054-1055.
 44. **Foust, David R.; Chaffin, Don B.; Snyder, Richard G. and Baum, Janet K.** "Cervical Range of Motion and Dynamic Response and Strength of Cervical Muscles." *Proceedings of the Seventeenth Stapp Car Crash Conference*, Nov. 12-13, 1973, pp. 285-308. Warrendale, Pa.: Society of Automotive Engineers, 1973.
 45. **Foust, David R.; Bowman, Bruce M. and Snyder, Richard G.** "Study of Human Impact Tolerance Using Investigations of Free-Falls." *Proceedings of the Twenty-first Stapp Car Crash Conference*, Oct. 19-21, 1977, pp. 3-51. Warrendale, Pa.: Society of Automotive Engineers, 1977.
 46. **Fulmer, Dan.** "120,000,000 Cars: A Look at the Law's Failure to Cope with Highway Killing." *Student Lawyer*, Vol. 3, No. 2 (October 1974), pp. 38-39, 47, 52-53.
 47. **Gertner, Harold R., Jr.; Baker, Susan P.; Rutherford, Robert B. and Spitz, Werner U.** "Evaluation of the Management of Vehicular Fatalities Secondary to Abdominal Trauma." *The Journal of Trauma*, Vol. 12, No. 5 (May 1972), pp. 425-431.
 48. **Haddon, William, Jr.** "The Shocking Facts About Drinking and Driving." *Popular Science*, Vol. 194, No. 5 (May 1969), pp. 78-81, 212.
 49. **Haddon, William, Jr.** "Our Unsafe Highways—A National Challenge." *The Journal of Insurance Information*, Vol. 30, No. 3 (May-June 1969), pp. 2-7.
 50. **Haddon, William, Jr. and Kelley, Albert Benjamin.** "IIHS Officials Demonstrate that Speed Does Kill." *The National Underwriter*, Sept. 5, 1969, pp. 1, 29.
 51. **Haddon, William, Jr. and Kelley, Albert Benjamin.** "IIHS Officials Look at Strategies for Cutting Highway Losses." *The National Underwriter*, October 10, 1969, pp. 2, 64. Reprinted as "Strategies for Cutting Highway Losses." In *Safety: Principles, Instruction and Readings*, edited by Alton L. Thygeson, pp. 92-94, Englewood Cliffs, N.J.: Prentice-Hall, 1972.
 52. **Haddon, William, Jr. and Kelley, Albert Benjamin.** "IIHS Officials Deplore Scant Press Treatment of Auto Crashes." *The National Underwriter*, November 14, 1969, pp. 1, 26. Reprinted as "Media Coverage of Car Crashes." *Traffic Digest and Review*, Vol. 18, No. 2 (February 1970), pp. 4-5; "Media Reporting of Traffic Accidents." *California Journal of Traffic Safety Education*, Vol. 17, No. 3 (March 1970), pp. 9-10.
 53. **Haddon, William, Jr.** "The Problem Drinker and Driving: Questions of Strategy in Countermeasure Choice and Development." *Proceedings of a Conference on Community Response to Alcoholism and Highway Crashes*, Nov. 18-19, 1969, pp. 13-19. Ann Arbor: Highway Safety Research Institute, University of Michigan, 1970.
 54. **Haddon, William, Jr. and Kelley, Albert Benjamin.** "IIHS Officials Clarify Status of Pre-Arrest Drunk Driver Test." *The National Underwriter*, Dec. 12, 1969, pp. 2, 54.
 55. **Haddon, William, Jr. and Kelley, Albert Benjamin.** *The 'Underwriter' Columns on Highway Loss Reduction*. Washington: Insurance Institute for Highway Safety, 1970.
 56. **Haddon, William, Jr.** *Why the Issue Is Loss Reduction Rather Than Only Crash Prevention*. SAE Paper No. 700196. Presented at the Automotive Engineering Congress, Jan. 12-16, 1970. Warrendale, Pa.: Society of Automotive Engineers, 1970. Reprinted in *Maryland State Medical Journal*, Vol. 19, No. 5 (May 1970), pp. 55-60.
 57. **Haddon, William, Jr. and Kelley, Albert Benjamin.** "IIHS Officials Eye Alarming Role of the Modern Muscle Car." *The National Underwriter*, Jan. 16, 1970, pp. 1, 24. Reprinted as "Muscle Cars—Newest Threat to Traffic Safety?" *Journal of Traffic Safety Education*, Vol. 18, No. 1 (October 1970), pp. 7-8.
 58. **Haddon, William, Jr.** *Testimony Before the Informal Hearing, U.S. Senate Committee on the Judiciary, Subcommittee on Antitrust and Monopoly Legislation*, Jan. 26, 1970 (Automotive Repair and Associated Costs). Washington: Insurance Institute for Highway Safety, 1970.

59. **Haddon, William, Jr.** "On the Escape of Tigers: An Ecologic Note." *Technology Review* (Massachusetts Institute of Technology), Vol. 72, No. 7 (May 1970), pp. 44-53. Reprinted as an Editorial (Without Reader's Quiz) in *American Journal of Public Health*, Vol. 60, No. 12 (December 1970), pp. 2229-2234; in (Without Reader's Quiz) *ASSE Journal*, Vol. 16, No. 9 (September 1971), pp. 30-33; and in *Selected Readings in Safety*, edited by Joanne T. Widner, pp. 120-129. Macon, Ga.: Academy Press, 1973; Reprinted (Edited): *Orthopaedic Review*, in press, May 1978.
60. **Haddon, William, Jr.** "What We're Talking About." In *Key Issues in Highway Loss Reduction: Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 7-22. Washington: Insurance Institute for Highway Safety, 1970.
61. **Haddon, William, Jr.** "Alcohol Abuse and the Baton Rouge Approach." In *Key Issues in Highway Loss Reduction: Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 25-27. Washington: Insurance Institute for Highway Safety, 1970.
62. **Haddon, William, Jr.** "Some Policy Options." In *Key Issues in Highway Loss Reduction: Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 203-213. Washington: Insurance Institute for Highway Safety, 1970.
63. **Haddon, William, Jr.** "Approaching the Epidemiology of Head Injury" (Editorial). *The Journal of Trauma*, Vol. 10, No. 8 (August 1970), pp. 712-714.
64. **Haddon, William, Jr.** "A Logical Framework for Categorizing Highway Safety Phenomena and Activity." *Proceedings, Tenth International Study Week in Traffic and Safety Engineering*, Sept. 7-11, 1970. London: World Touring and Automobile Organisation (OTA), 1971. Reprinted in *The Journal of Trauma*, Vol. 12, No. 3 (March 1972), pp. 193-207; in *Insurance Law Proceedings, Property and Liability Meeting, Section of Insurance Negligence and Compensation Law*, pp. 54-74. Chicago: American Bar Association, 1971; and *CPCU II, Selected Readings and Insurance Survey Cases, Analysis of Insurance Functions, June 1973 Examinations*, pp. 33-44. Bryn Mawr, Pa.: American Institute for Property and Liability Underwriters, 1972.
65. **Haddon, William, Jr.** *Reducing Truck and Bus Losses—Neglected Countermeasures*. SAE Paper No. 710409. Presented at the Automotive Engineering Congress, Jan. 11-15, 1971. Warrendale, Pa.: Society of Automotive Engineers, 1971.
66. **Haddon, William, Jr.** "The Insurance Industry: A Third Force for Environmental Problem Solving?" *Making Our Cities Livable: Proceedings of the Seventh Annual Meeting of the American Insurance Association*, May 18-19, 1971, pp. 41-49. New York: American Insurance Association, 1971. Reprinted in *The Weekly Underwriter*, July 24, 1971, pp. 20-22, 25, 29.
67. **Haddon, William, Jr.** "Approaching the Reduction of Road Losses—Replacing Guesswork with Logic, Specificity, and Scientifically Determined Fact." *Papers Presented at the National Road Safety Symposium*, March 14-16, 1972, pp. 21-41. Canberra, Australia: Australian Government Publishing Service, 1972.
68. **Haddon, William, Jr.** "Road Safety Problems and Action Programs—The U.S. Approach." *Papers Presented at the National Road Safety Symposium*, March 14-16, 1972, pp. 579-612. Canberra, Australia: Australian Government Publishing Service, 1972. Reprinted for distribution to institutions and officials of less developed member countries by the Economic Development Institute of the International Bank for Reconstruction and Development, Washington, D.C., January 1974.
69. **Haddon, William, Jr.** "Exploring the Options." In *Research Directions Toward the Reduction of Injury in the Very Young and Very Old: Report of a Conference*, May 12-14, 1971. DHEW Publication No. (NIH) 73:124, pp. 38-59. Bethesda, Md.: National Institute of Child Health and Human Development, 1973.
70. **Haddon, William, Jr.** "Energy Damage and the Ten Countermeasure Strategies." *The Journal of Trauma*, Vol. 13, No. 4 (April 1973), pp. 321-331; and in *Conference Proceedings, International Conference on the Biokinetics of Impacts*, June 26-27, 1973, pp. 489-505. Lyon, France: Organisme National de Securite Routiere, 1973.
71. **Haddon, William, Jr.** "Ten Ways to Prevent or Attenuate Accidental Injury Damage." (An Abstract of "Energy Damage and the Ten Countermeasure Strategies" prepared by Robert A. Alkov, Naval Safety Center.) *Lifeline: The Naval Safety Journal*, Vol. 2, No. 2 (March-April 1973), pp. 3-5.

72. **Haddon, William, Jr.** "Strategy in Preventive Medicine: Passive vs. Active Approaches to Reducing Human Wastage" (Editorial). *Newsletter of the American College of Preventive Medicine*, Vol. 15, No. 2 (1974), p. 3. Reprinted in *The Journal of Trauma*, Vol. 14, No. 4 (April 1974), pp. 353-354.
73. **Haddon, William, Jr.** "Damage to People and Property Associated with Motor Vehicle Use: A Failure of Ecologic Understanding and Application." Presented at the Alumni Day Program on "Automobility," Massachusetts Institute of Technology, June 3, 1974. (Unpublished)
74. **Haddon, William, Jr.** "Some Aspects of Information for Consumers." Presented at the Conference on Consumerism, University of Illinois, Urbana, Oct. 10-13, 1974. In *Consumerism: A New Force in Society*, edited by Mary Gardiner Jones and David M. Gardner, Lexington, Mass.: Lexington Books, 1976, pp. 69-74.
75. **Haddon, William, Jr.** *Statement at the National Highway Traffic Safety Administration Public Meeting on a Proposed Bumper Standard*, Feb. 18, 1975 (Dockets 74-11, Notice 6; 73-19, Notice 4), Washington: Insurance Institute for Highway Safety, 1975.
76. **Haddon, William, Jr. and Kelley, Albert Benjamin.** *Statement at the National Highway Traffic Safety Administration Public Meeting on Standard No. 208, Occupant Crash Protection*, May 19, 1975. Washington: Insurance Institute for Highway Safety, May 1975.
77. **Haddon, William, Jr.** "Reducing the Damage of Motor-Vehicle Use." *Technology Review* (Massachusetts Institute of Technology), Vol. 77, No. 8 (August 1975), pp. 53-59. Also excerpted in *Best's Review*, Vol. 76, No. 10 (February 1976), pp. 14-16.
78. **Haddon, William, Jr.** "Lumbar Disc Lesions, an Illustration of Slowly Occurring Injury." *The American Journal of Epidemiology*, Vol. 102, No. 5 (1975), p. 357.
79. **Haddon, William, Jr.** "Perspective on a Current Public Health Controversy" (Editorial). *American Journal of Public Health*, Vol. 65, No. 12 (December 1975), pp. 1342-1344.
80. **Haddon, William, Jr.** *Statement Before William T. Coleman, Jr., Secretary of Transportation, Public Hearing on Motor Vehicle Occupant Crash Protection*, Aug. 3, 1976. Washington: Insurance Institute for Highway Safety, August 1976.
81. **Haddon, William, Jr.** *Statement at Public Meeting Concerning a Proposal of the Motor Vehicle Administration, Maryland Department of Transportation, to Adopt Regulations VESC-15 and VESC-16 Issued by the Vehicle Equipment Safety Commission*, Aug. 10, 1976 (Vehicle Identification Numbers). Washington: Insurance Institute for Highway Safety, August 1976.
82. **Haddon, William, Jr. and Kelley, Albert Benjamin.** *Statement Before the Senate Committee on Commerce, Science and Transportation, Consumer Subcommittee Hearings on Truck-Car Crash Safety*, March 16, 1977. Washington: Insurance Institute for Highway Safety, March 1977.
83. **Haddon, William, Jr.** *Statement at Public Hearing on Occupant Crash Protection Alternatives for Passenger Cars Before Brock Adams, Secretary of Transportation*, April 27, 1977. Washington: Insurance Institute for Highway Safety, April 1977.
84. **Haddon, William, Jr.** "The Second William S. Stone Lecture of the American Trauma Society." *The Journal of Trauma*, in press, 1978.
85. **Haddon, William, Jr.** *Statement Before the National Highway Traffic Safety Administration Public Meeting on Electric and Hybrid Vehicles*, July 14, 1977. Washington: Insurance Institute for Highway Safety, July 1977.
86. **Haddon, William, Jr.; Kelley, Ben and O'Neill, Brian.** *Statement Before the Senate Committee on Commerce, Science and Transportation, Consumer Subcommittee Hearings on the Passive Restraint Decision by the U.S. Department of Transportation*, September 9, 1977. Washington: Insurance Institute for Highway Safety, Sept. 9, 1977.
87. **Haddon, William, Jr.; Kelley, Ben and O'Neill, Brian.** *Statement Before the House Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance Hearings on the Passive Restraint Decision by the U.S. Department of Transportation*, Sept. 12, 1977. Washington: Insurance Institute for Highway Safety, Sept. 12, 1977.
88. **Haddon, William, Jr. and Baker, Susan P.** "Injury Control." In *Preventive Medicine*, edited by D. W. Clark and B. MacMahon, 2nd ed., Boston: Little Brown, in press, 1978.
89. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages: Variations by Make and Series, 1972 Models*. Research Report HLDI R72-1. Washington: Highway Loss Data Institute, June 1973.

90. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Initial Results for 1973 Models Compared with 1972 Models.* Research Report HLDI R73-1. Washington: Highway Loss Data Institute, September 1973.
91. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1973 Models.* Research Report HLDI R73-2. Washington: Highway Loss Data Institute, March 1974.
92. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; A Comparison of Results for 1972 and 1973 Models.* Research Report HLDI A-1. Washington: Highway Loss Data Institute, May 1974.
93. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Initial Results for 1974 Models.* Research Report HLDI R74-1. Washington: Highway Loss Data Institute, May 1974.
94. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Relationships Between Losses and Vehicle Density, 1972 and 1973 Models.* Research Report HLDI A-2. Washington: Highway Loss Data Institute, September 1974.
95. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1973 Models During Their First Two Years.* Research Report HLDI R73-3. Washington: Highway Loss Data Institute, December 1974.
96. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1974 Models During Their First Year.* Research Report HLDI R74-2. Washington: Highway Loss Data Institute, December 1974.
97. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; A Comparison of Results for 1973, 1974 and 1975 Models.* Research Report HLDI A-3. Washington: Highway Loss Data Institute, July 1975.
98. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1975 Models During Their First Year.* Research Report HLDI R75-1. Washington: Highway Loss Data Institute, July 1975.
99. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1975 Models During Their First Year.* Research Report R75-2. Washington: Highway Loss Data Institute, December 1975.
100. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1974 Models During Their First Two Years.* Research Report HLDI R74-3. Washington: Highway Loss Data Institute, December 1975.
101. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series, 1973 Models During Their First Three Years.* Research Report HLDI R73-4. Washington: Highway Loss Data Institute, December 1975.
102. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Relationships Between Losses and Vehicle Density, 1974 and 1975 Models.* Research Report HLDI A-4. Washington: Highway Loss Data Institute, December 1975.
103. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Relationships Between Losses and Vehicle Body Style, 1974 and 1975 Models.* Research Report HLDI A-5. Washington: Highway Loss Data Institute, December 1975.
104. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Initial Results for 1976 Models.* Research Report HLDI R76-1. Washington: Highway Loss Data Institute, June 1976.
105. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; An Investigation of Relationships Between Losses and Engine Specifications Using 1973 Models.* Research Report HLDI A-6. Washington: Highway Loss Data Institute, June 1976.
106. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Annual Increases and Seasonal Variations, 1972, 1973, 1974 and 1975 Models.* Research Report HLDI A-7. Washington: Highway Loss Data Institute, June 1976.
107. **Highway Loss Data Institute.** *Automobile Insurance Losses, Injury Coverages; Claim Frequency Results for 1974 and 1975 Models.* Research Report HLDI I 75-1. Washington: Highway Loss Data Institute, June 1976.
108. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series; 1976 Models During Their First Year; 1975 Models During Their First Two Years; 1974 Models During Their First Three Years.* Research Report HLDI R76-2. Washington: Highway Loss Data Institute, December 1976.

109. **Highway Loss Data Institute.** *Automobile Insurance Losses, Percentage of Collision Coverage Claims with Associated Injury Claims for 1974 and 1975 Models.* Research Report HLDI 175-2. Washington: Highway Loss Data Institute, March 1977.
110. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Initial Results for 1977 Models.* Research Report HLDI R77-1. Washington: Highway Loss Data Institute, June 1977.
111. **Highway Loss Data Institute.** *Automobile Insurance Losses, Injury Coverages; A Preliminary Comparison of Results from Volkswagen Rabbit with Passive and Active Belts—1975 and 1976 Models.* Research Report HLDI A-8. Washington: Highway Loss Data Institute, June 1977.
112. **Highway Loss Data Institute.** *Automobile Insurance Losses, Injury Coverages; Claim Frequency Results for 1974, 1975, and 1976 Models.* Research Report HLDI 176-1. Washington: Highway Loss Data Institute, November 1977.
113. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; A Comparison of Collision Claim Size Distribution for 1974, 1975, and 1976 Models.* Research Report HLDI A-9. Washington: Highway Loss Data Institute, November 1977.
114. **Highway Loss Data Institute.** *Automobile Insurance Losses, Collision Coverages; Variations by Make and Series—1977 Models During Their First Year; 1976 Models During Their First Two Years; 1975 Models During Their First Three Years.* Research Report HLDI R77-2. Washington: Highway Loss Data Institute, December 1977.
115. **Hogland, T. J.; Kaye, J. R. and Weinberg, H. P.** *Metallurgical Investigation of Lower Control Arms.* Report No. 14-RD-70. Alexandria, Va.: Value Engineering Laboratory, May 15, 1970.
116. **Hogland, T. J.; Kaye, J. R. and Weinberg, H. P.** *Metallurgical Investigation of Lower Control Arms.* Report No. 18-RD-70. Alexandria, Va.: Value Engineering Laboratory, May 29, 1970.
117. **Holloway, John T.** "Vehicle Design Loss Factors: The Crash Tests of the 1970 Models." In *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 161-169. Washington: Insurance Institute for Highway Safety, 1970.
118. **Holloway, John T.** "The Low Speed Crash Tests—Some Surprises." In *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 215-228. Washington: Insurance Institute for Highway Safety, 1970.
119. **Hricko, Andrew R.** "Highway Safety—The New Era." *Federation of Insurance Counsel Quarterly*, Vol. 19, No. 4 (Summer 1969), pp. 41-47.
120. **Hricko, Andrew R.** "British Pre-Arrest Breath Tests—Constitutional in the United States?" Presented at the Institute on Motor Vehicle and Traffic Law, University of Colorado, Aug. 18-21, 1969. Printed in *Traffic Digest and Review*, Vol. 17, No. 12 (December 1969), pp. 1-6.
121. **Hricko, Andrew R.** "Our Booby-Trapped Highways." *This Day* (April 1970), pp. 34-37.
122. **Hricko, Andrew R.** "Driver License Suspension . . . A Paper Tiger." *Police Chief*, Vol. 37, No. 2 (February 1970), pp. 20-23. Reprinted in *Safety Briefs* (Magazine of the New Jersey State Safety Council), Vol. 32, No. 4 (April 1971), pp. 3-6; and in *Minutes* (Magazine of Nationwide Insurance), Summer 1970, pp. 7-9.
123. **Hricko, Andrew R.** "Finding Booby-Trapped Highways and Their Perpetrators." In *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 133-137. Washington: Insurance Institute for Highway Safety, 1970. Reprinted in *Bulletin* (United States Fidelity and Guarantee Companies), Vol. 68, No. 4 (Winter 1970-1971), pp. 17-19. Also reprinted in *Federation of Insurance Counsel Quarterly*, Vol. 21, No. 3 (Spring 1971), pp. 41-44.
124. **Hricko, Andrew R.** "Pre-Arrest Breath Tests." In *Key Issues in Highway Safety Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 59-64. Washington: Insurance Institute for Highway Safety, 1970.
125. **Hricko, Andrew R.** "Alcohol Has Menacing Role in Flight Safety as on Highways." *National Underwriter*, Aug. 7, 1970, pp. 1-5. Reprinted as "High in the Sky," *Private Pilot*, Vol. 6, No. 1 (January 1971), pp. 49-52.

126. **Hricko, Andrew R.** "Roadside Hazards—Responsibility and Liability." *Federation of Insurance Counsel Quarterly*, Vol. 25, No. 1 (Fall 1974), pp. 3-13.
127. **Hricko, Andrew R.** "Motor Vehicle Administrators Potential Liability—Licensing of Alcoholics." *Federation of Insurance Counsel Quarterly*, Vol. 26, No. 2 (Winter 1976), pp. 75-87.
128. **Hricko, Andrew R.** "Air Bag Legislation: Precedents Have Been Set." *The National Underwriter*, Dec. 10, 1976, pp. 22, 28-30.
129. **Hricko, Andrew R.** "T. J. Hooper and the Air Bag." *Federation of Insurance Counsel Quarterly*, Vol. 27, No. 3 (Spring 1977), pp. 233-243.
130. **Hubacher, Jack S.; Jarmon, D. C. and Lapointe, G. P.** *Evaluation of the Steering Obstruction Problem*. Report No. 6-RD-72. Alexandria, Va.: Value Engineering Laboratory, March 1972.
131. **Insurance Institute for Highway Safety.** *Status Report*. Vol. 4—Current, January 1969—Current. Washington: Insurance Institute for Highway Safety.
132. **Insurance Institute for Highway Safety.** *Instruction Manual for "In the Crash"* (A film produced by the Insurance Institute for Highway Safety). Washington: Insurance Institute for Highway Safety, 1970.
133. **Insurance Institute for Highway Safety.** *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom. Washington: Insurance Institute for Highway Safety, 1970.
134. **Insurance Institute for Highway Safety.** *The Ford Lower Control Arm Safety Defect Case: An Analysis by the Insurance Institute for Highway Safety Presented to the Department of Transportation at the Public Meeting, March 20, 1974, re: NHTSA ODI Case No. 212*. Washington: Insurance Institute for Highway Safety, 1974.
135. **Insurance Institute for Highway Safety.** Submission to the Secretary of Transportation in the matter of Federal Motor Vehicle Safety Standard 208, Occupant Crash Protection. Document I—Air Bags and Lap/Shoulder Belts—A Comparison of Their Effectiveness in Real World Frontal Crashes; Document II—Selected Points Called to the Secretary's Attention; Document III—A Critique of the Benefit/Cost Analysis Accompanying the Announcement of the Aug. 3, 1976, DOT Public Hearing on Motor Vehicle Occupant Crash Protection; and Document IV—Recommendations to the Secretary in the Matter of FMVSS 208. Washington: Insurance Institute for Highway Safety, Sept. 17, 1976.
136. **Insurance Institute for Highway Safety.** *Background Manual on the Passive Restraint Issue*. Washington: Insurance Institute for Highway Safety, August 1977.
137. **Insurance Institute for Highway Safety.** *Safety Belt Use: A Fact Sheet*. Washington: Insurance Institute for Highway Safety, Oct. 11, 1977.
138. **Insurance Institute for Highway Safety.** *A Thumbnail History of Federal Bumper Standards*. Washington: Insurance Institute for Highway Safety, Nov. 15, 1977.
139. **International Association of Chiefs of Police.** *The Role of Police in Roadside Hazard Identification and Reporting*. Gaithersburg, Md.: International Association of Chiefs of Police, June 1976.
140. **Joks, Hans C.** "A Critical Appraisal of the Applicability of Benefit Cost Analysis to Highway Traffic Safety," *Accident Analysis and Prevention*, Vol. 7, No. 2 (June 1975), pp. 133-153.
141. **Karlson, Trudy A.; Baker, Susan P. and Morton, Bert F.** "Fatally Injured Truck Drivers." *Proceedings of the 21st Conference of the American Association for Automotive Medicine*, Sept. 15-17, 1977, pp. 367-378. Morton Grove, Ill. American Association for Automotive Medicine, 1977.
142. **Katz, P. R.; Reynolds, H. M.; Foust, David R. and Baum, Janet K.** "Mid-Sagittal Dimensions of Cervical Vertebra Bodies." *American Journal of Physical Anthropology*, Vol. 43, No. 3 (November 1975), pp. 319-326.
143. **Kelley, Albert Benjamin.** *Testimony Before the U.S. House Appropriations Committee, Subcommittee on Transportation*, Oct. 22, 1969 (Cost of Crash Losses). Washington: Insurance Institute for Highway Safety, 1969.
144. **Kelley, Albert Benjamin.** *Testimony Before the U.S. Senate Appropriations Committee, Subcommittee on Transportation*, Oct. 30, 1969 (Appropriations for the Highway Safety Program). Washington: Insurance Institute for Highway Safety, 1969.

145. **Kelley, Albert Benjamin.** *About Hot Cars.* Presented at the Annual Meeting of the Greater Jacksonville Safety Council, Jacksonville, Florida, Dec. 17, 1969. Washington: Insurance Institute for Highway Safety, 1969.
146. **Kelley, Albert Benjamin.** "Highway Losses: Nature's Plan or Man's Folly?" *Concepts* (Aetna Life and Casualty), Vol. 3, No. 1 (Spring 1970), pp. 11-13.
147. **Kelley, Albert Benjamin.** "Baton Rouge Project: Where to from Here?" In *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 65-70. Washington: Insurance Institute for Highway Safety, 1970. Reprinted in *National Safety Congress Transactions; Papers Delivered at the Fifty-eighth National Safety Congress*, Vol. 54, 1970. Chicago: National Safety Council, 1970, pp. 58-61.
148. **Kelley, Albert Benjamin.** "How Government Does—and Doesn't—Work." In *Key Issues in Highway Loss Reduction; Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 195-202. Washington: Insurance Institute for Highway Safety, 1970.
149. **Kelley, Albert Benjamin.** "Loss Reduction—A New Dimension in Driver Education?" *Traffic Safety*, Vol. 71, No. 6 (June 1971), pp. 8-11, 38.
150. **Kelley, Albert Benjamin.** "Our Booby-Trapped Highways." *World*, Vol. 2, No. 6 (March 13, 1973), pp. 30-32.
151. **Kelley, Albert B.** *Presentation Before the Safety Defects Conference of the National Motor Vehicle Safety Advisory Council*, October 9, 1973. Washington: Insurance Institute for Highway Safety, October 1973.
152. **Kelley, Albert Benjamin.** *Speed and Car Crashworthiness: Unfixing a Great Gulf.* Presented to the Section on Injury Control and Emergency Health Services, American Public Health Association, Nov. 6, 1973. Washington: Insurance Institute for Highway Safety, 1973.
153. **Kelley, Albert Benjamin.** "Are Some Public Health Problems More Equal Than Others?" (Editorial). *American Journal of Public Health*, Vol. 65, No. 2 (February 1975), p. 182.
154. **Kelley, Albert Benjamin.** *Passive vs. Active = Life vs. Death.* SAE Paper No. 750391. Presented at the Automotive Engineering Congress, Feb. 24-28, 1975. Warrendale, Pa.: Society of Automotive Engineers, 1975.
155. **Kelley, Albert Benjamin.** *Testimony Before the U.S. Senate Committee on Commerce*, March 14, 1975 (Results and Films from the 1975 IIHS Low Speed Crash Tests). Washington: Insurance Institute for Highway Safety, 1975.
156. **Kelley, Albert Benjamin.** *Statement at the National Highway Traffic Safety Administration Public Meeting on a Hydraulic Brake System Standard*, April 1, 1975 (Docket 70-27, Notice 12). Washington: Insurance Institute for Highway Safety, 1975.
157. **Kelley, Albert Benjamin.** *Statement at the National Highway Traffic Safety Administration Public Meeting on a Proposed Bumper Standard*, April 4, 1975 (Dockets 74-11, Notice 7; 73-19, Notice 6). Washington: Insurance Institute for Highway Safety, 1975.
158. **Kelley, Albert Benjamin.** *Statement at the National Highway Traffic Safety Administration Public Meeting on Standard No. 208, Occupant Crash Protection*, May 23, 1975. Washington: Insurance Institute for Highway Safety, May 1975.
159. **Kelley, Albert Benjamin.** "More or Less Regulation?: The Wrong Issue." Remarks Before the General Session Panel, Fourth International Congress on Automotive Safety, July 14-16, 1975. Washington: Insurance Institute for Highway Safety, 1975.
160. **Kelley, Albert Benjamin.** "A Comment on Motorcycles." Presented at the American Association for Automotive Medicine Annual Meeting, Nov. 21, 1975. Washington: Insurance Institute for Highway Safety, 1975.
161. **Kelley, Albert Benjamin.** "Commentary: Motorcycles and Public Apathy." *American Journal of Public Health*, Vol. 66, No. 5 (May 1976), pp. 475-476.
162. **Kelley, Albert Benjamin and O'Neill, Brian.** *Statement Before the House Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance Oversight Hearings on the Motor Vehicle Information and Cost Savings Act of 1972*, May 6, 1977. Washington: Insurance Institute for Highway Safety, 1977.
163. **Kelley, Ben.** "Highway Slaughter: By Caring, We Could Stop It." *Washington Post*, July 2, 1977, p. A15. Washington: Insurance Institute for Highway Safety, 1977.

164. Kelley, Ben. *Statement Before the National Highway Traffic Safety Administration Public Meeting-Damageability Requirements and Consumer Information*, July 28, 1977. Washington: Insurance Institute for Highway Safety, 1977.
165. Kelley, A. B. "A Media Role for Public Health Compliance?" In *Compliance with Therapeutic and Preventive Regimens*, edited by R. B. Haynes, D. W. Taylor and D. L. Sackett. Baltimore: Johns Hopkins University Press, in press, 1978.
166. Kelley, Albert Benjamin and O'Neill, Brian. *Statement Before the Senate Committee on Commerce, Science, and Transportation, Consumer Subcommittee Oversight Hearings on the National Traffic and Motor Vehicle Safety Act of 1966 and the Motor Vehicle Information and Cost Savings Act of 1972*, March 22, 1978. Washington: Insurance Institute for Highway Safety, March 1978.
167. Kewalramani, L. S. and Kraus, Jess F. "Acute Spinal-Cord Lesions from Diving—Epidemiological and Clinical Features." *Western Journal of Medicine*, Vol. 126 (May 1977), pp. 353-361.
168. Kewalramani, L. S.; Kraus, J. F. and Sterling, H. M. "Acute Spinal Cord Lesions in a Pediatric Population: Epidemiological and Clinical Features." *Journal of Paraplegia*, in press.
169. Kraus, Jess F.; Riggins, Richard S.; Drysdale, Walter and Franti, Charles E. "Some Epidemiologic Features of Motorcycle Injury in a California Community (A Preliminary Report)." Presented to the Epidemiology Section of the American Public Health Association at the 100th Annual Meeting, Nov. 14, 1972. (Unpublished)
170. Kraus, Jess F.; Franti, Charles E.; Riggins, Richard S.; Richards, Dana and Borhani, Nemat O. "Incidence of Traumatic Spinal Cord Lesions." *Journal of Chronic Diseases*, Vol. 28 (1975), pp. 471-492.
171. Kraus, Jess F.; Riggins, Richard S. and Franti, Charles E. "Some Epidemiologic Features of Motorcycle Collision Injuries: I. Introduction, Methods and Factors Associated with Incidence." *American Journal of Epidemiology*, Vol. 102, No. 1 (1975), pp. 74-98.
172. Kraus, Jess F.; Riggins, Richard S. and Franti, Charles E. "Some Epidemiologic Features of Motorcycle Collision Injuries: II. Factors Associated with Severity of Injuries." *American Journal of Epidemiology*, Vol. 102, No. 1 (1975), pp. 99-109.
173. Kraus, Jess F.; Franti, Charles E. and Johnson, Stephen L. "Trends in Deaths Due to Motorcycle Crashes and Risk Factors in Injury Collisions." *Accident Analysis and Prevention*, Vol. 8, No. 4 (December 1976), pp. 247-255.
174. Kraus, Jess F.; Franti, Charles; Riggins, Richard S. and Borhani, Nemat O. *Survival with an Acute Spinal-Cord Injury*. Davis, Ca.: School of Medicine, University of California, August 1977.
175. Lapointe, G. P. and Weinberg, H. P. *Investigation of Metallurgical Factors Involved in Lower Control Arm Failures*. Report No. 77-RD-71. Alexandria, Va.: Value Engineering Laboratory, December 1971.
176. Levine, Donald N. and Campbell, B. J. "Effectiveness of Lap Seat Belts and the Energy Absorbing Steering System in Reduction of Injuries." *Journal of Safety Research*, Vol. 4, No. 3 (September 1972), pp. 106-107.
177. Maryland Motor Vehicle Administration; Maryland State Police and the Insurance Institute for Highway Safety. "A Summary Review of the TAGS Vehicle Screening Project." Presented at the Fifty-third Annual Conference, Region 1, American Association of Motor Vehicle Administrators, June 24, 1974. Washington: Insurance Institute for Highway Safety, 1974.
178. McLean, A. J. "The Man in the Street—Pedestrian Accidents in the Empire State." *Proceedings of the Fifteenth Conference of the American Association for Automotive Medicine*, Oct. 20-23, 1971, pp. 97-121. Warrendale, Pa.: Society of Automotive Engineers, 1972.
179. Mendelson, Jack H. and Mello, Nancy K. "Alcohol, Aggression and Androgens." In *Research Publications Association for Research in Nervous and Mental Disease; Proceedings of the Association*, Dec. 1-2, 1972, New York, N.Y., Vol. 52, Aggression, pp. 225-247, edited by Shervert H. Frazier. Baltimore: Williams & Wilkins, 1974.
180. Mendelson, Jack H.; Mendelson, John E. and Patch, Vernon D. "Plasma Testosterone Levels in Heroin Addiction and During Methadone Maintenance." *Journal of Pharmacology and Experimental Therapeutics*, Vol. 192, No. 1 (1975), pp. 211-217.
181. Miller, A. Eugene. *Summary Report on Project TAGS—An Experiment in Mass Screening of License Plates to Identify Motor Vehicle Law Violations*. Washington: Insurance Institute for Highway Safety, May 1978.

182. Mohan, Dinesh; Zador, Paul; O'Neill, Brian and Ginsburg, Marvin. "Air Bags and Lap/Shoulder Belts—A Comparison of Their Effectiveness in Real World Frontal Crashes." *Proceedings of the Twentieth Conference of the American Association for Automotive Medicine*, Nov. 1-3, 1976, pp. 315-335. Morton Grove, Ill.: American Association for Automotive Medicine, 1976.
183. Moskowitz, H. and Burns, M. "The Effects of Alcohol and Valium, Singly and in Combination, upon Driving-Related Skills Performance." *Proceedings of the Twenty-first Conference of the American Association for Automotive Medicine*, Sept. 15-17, 1977, pp. 226-240. Morton Grove, Ill.: American Association for Automotive Medicine, 1977.
184. Moskowitz, Herbert A. *Supplemental Testimony in the Matter of Benlyn Expectorant: Proposed Denial of Approval of Supplemental New Drug Application No. 6-514/S-007*. Submitted to the Department of Health, Education and Welfare Docket 76N-0483, Sept. 26, 1977. Washington: Insurance Institute for Highway Safety, September 1977.
185. O'Neill, Brian and Wells, W. T. "Blood Alcohol Levels in Drivers Not Involved in Accidents and the Lognormal Distribution." *Quarterly Journal of Studies on Alcohol*, Vol. 32, No. 3 (September 1971), pp. 798-803.
186. O'Neill, Brian and Prouty, Richard W. "An Evaluation of Some Qualitative Breath Screening Tests for Alcohol." *Proceedings of the Fifteenth Conference of the American Association for Automotive Medicine*, Oct. 20-23, 1971, pp. 261-296. Warrendale, Pa.: Society of Automotive Engineers, 1972.
187. O'Neill, Brian; Haddon, William, Jr.; Kelley, Albert Benjamin and Sorenson, Wayne W. "Automobile Head Restraints: Frequency of Neck Injury Claims in Relation to the Presence of Head Restraints." *American Journal of Public Health*, Vol. 62, No. 3 (March 1972), pp. 399-406.
188. O'Neill, Brian and Wells, W. T. "Some Recent Results in Lognormal Parameter Estimation Using Grouped and Ungrouped Data." *Journal of the American Statistical Association*, Vol. 67, No. 337 (March 1972), pp. 76-80.
189. O'Neill, Brian and Eiswirth, Richard S. "Screening Drivers for Alcohol—An Application of Bayes' Formula." *American Journal of Public Health*, Vol. 62, No. 11 (November 1972), pp. 1468-1472.
190. O'Neill, Brian. *Statement at the Department of Transportation Public Meeting on a Proposed Bumper Standard*, Sept. 13, 1973 (Docket 73-19). Washington: Insurance Institute for Highway Safety, 1973.
191. O'Neill, Brian; Joksche, Hans and Haddon, William, Jr. "Relationships Between Car Size, Car Weight, and Crash Injuries in Car-to-Car Crashes." *Proceedings of the Third International Congress on Automotive Safety*, July 15-17, 1974, pp. 2-1—2-27. Washington: U.S. Government Printing Office, 1974.
192. O'Neill, Brian and Kelley, Albert Benjamin. *Costs, Benefits, Effectiveness and Safety: Setting the Record Straight*. SAE Paper No. 740988. Presented at the Automobile Engineering Congress, Society of Automotive Engineers, Oct. 21-25, 1974. Warrendale, Pa.: Society of Automotive Engineers, 1974. Reprinted in *Professional Safety*, Vol. 20, No. 8 (August 1975), pp. 28-34.
193. O'Neill, Brian. "Comments on 'An Evaluation of the National Safety Council's Defensive Driving Course in Various States.'" *Accident Analysis and Prevention*, Vol. 6, No. 3/4 (December 1974), pp. 299-301.
194. O'Neill, Brian. *Statement at the National Highway Traffic Safety Administration Public Meeting on a Proposed Bumper Standard*, Feb. 18, 1975 (Dockets 74-11, Notice 6; 73-19, Notice 4). Washington: Insurance Institute for Highway Safety, 1975.
195. O'Neill, Brian. *Statement at the National Highway Traffic Safety Administration Public Meeting on Standard No. 208, Occupant Crash Protection*, May 23, 1975. Washington: Insurance Institute for Highway Safety, May 1975.
196. O'Neill, Brian; Kelley, Albert Benjamin and Wong, Jackson. "Evaluating Motor Vehicle Safety Performance Standards." *Proceedings of the Fourth International Congress on Automotive Safety*, July 14-16, 1975, pp. 551-560. Washington: U.S. Government Printing Office, 1975.
197. O'Neill, Brian. "The Role of the Vehicle in Highway Loss Reduction." *Compendium of Technical Papers, Institute of Traffic Engineers Forty-fifth Annual Meeting*, Aug. 17-21, 1975, pp. 58-63. Arlington, Va.: Institute of Traffic Engineers, 1975.
198. O'Neill, Brian. *Statement at the Vehicle Equipment Safety Commission Meeting*, Dec. 11, 1975 (Concerning Vehicle Identification Numbers). Washington: Insurance Institute for Highway Safety, December 1975.

199. **O'Neill, Brian.** *Statement at the National Motor Vehicle Safety Advisory Council's Meeting on the National Highway Traffic Safety Administration's Safety Defect and Recall Program, Jan. 28, 1976.* Washington: Insurance Institute for Highway Safety, January 1976.
200. **O'Neill, Brian.** *Vehicle Identification Number Performance and Prospects for Improvement Through Standards.* Submitted to National Highway Traffic Safety Administration's Docket on Federal Motor Vehicle Safety Standard 115, Vehicle Identification Number. Washington: Insurance Institute for Highway Safety, August 1976.
201. **O'Neill, Brian.** *Statement Before the Vehicle Equipment Safety Commission on Regulations VESC-15 and VESC-16 (Vehicle Identification Number Regulations).* Washington: Insurance Institute for Highway Safety, May 9, 1977.
202. **O'Neill, Brian and Wong, Jackson.** *A Laboratory Evaluation of a Low Cost Motor Vehicle Crash Recorder.* Washington: Insurance Institute for Highway Safety, September 1977.
203. **O'Neill, Brian; Ginsburg, Marvin and Robertson, Leon.** "The Effects of Vehicle Size on Passenger Car Occupant Death Rates." SAE Paper No. 770808. Presented at the Passenger Car Meeting, Sept. 26-30, 1977. Warrendale, Pa.; Society of Automotive Engineers, 1977.
204. **O'Neill, Brian.** *Statement Before the National Highway Safety Advisory Committee on the National Highway Traffic Safety Administration's Proposed Rule on Vehicle Identification Numbers, March 21, 1978.* Washington: Insurance Institute for Highway Safety, March 1978.
205. **Patel, Arunbhai H. and Vinson, Joe A.** *Detection and Quantitation of Tetrahydrocannabinol in Serum.* Scranton, Pa.: University of Scranton, November 1976.
206. **Persky, Harold; O'Brien, Charles P.; Fine, Eric; Howard, William J.; Khan, Miftah A. and Beck, Roy W.** "The Effect of Alcohol and Smoking on Testosterone Function and Aggression in Chronic Alcoholics." *American Journal of Psychiatry*, Vol. 134, No. 6 (June 1977), pp. 621-625.
207. **Prouty, Richard W. and O'Neill, Brian.** *An Evaluation of Some Qualitative Breath Screening Tests for Alcohol.* Washington: Insurance Institute for Highway Safety, May 1971.
208. **Reinfurt, Donald W.; House, Elizabeth G. and Levine, Donald N.** *Periodic Motor Vehicle Inspection in North Carolina: A Follow-up Study.* Chapel Hill: Highway Safety Research Center, University of North Carolina, November 1971.
209. **Reinfurt, Donald W. and Symons, Michael J.** *Statistical Techniques for Evaluating the Effectiveness of State Motor Vehicle Inspection Programs in Reducing Highway Accidents.* Chapel Hill: Highway Safety Research Center, University of North Carolina, March 1974.
210. **Reisinger, Keith S. and Williams, Allan F.** "Evaluation of Programs Designed to Increase the Protection of Infants in Cars." *Pediatrics*, in press.
211. **Riggins, R. S. and Kraus, Jess F.** "The Risk of Neurological Damage with Fractures of the Vertebrae." *The Journal of Trauma*, Vol. 17, No. 2 (1977), pp. 126-133.
212. **Robbins, D. H.; Snyder, Richard G.; Chaffin, Don B. and Foust, David R.** *A Mathematical Study of the Effect of Neck Physical Parameters on Injury Susceptibility.* SAE Paper No. 740274. Presented at the Automotive Engineering Congress, Feb. 25-March 1, 1974. Warrendale, Pa.: Society of Automotive Engineers, 1974.
213. **Robertson, Leon S.; O'Neill, Brian and Wixom, Charles W.** "Factors Associated with Observed Safety Belt Use." *Journal of Health and Social Behavior*, Vol. 13, No. 1 (March 1972), pp. 18-24.
214. **Robertson, Leon S.; Rich, Robert F. and Ross, H. Laurence.** "Jail Sentences for Driving While Intoxicated in Chicago: A Judicial Policy that Failed." *Law and Society Review*, Vol. 8, No. 1 (Fall 1973), pp. 55-67.
215. **Robertson, Leon S. and Haddon, William, Jr.** "The Buzzer-Light Reminder System and Safety Belt Use." *American Journal of Public Health*, Vol. 64, No. 8 (August 1974), pp. 814-815.
216. **Robertson, Leon S.; Kelley, Albert Benjamin; O'Neill, Brian; Wixom, Charles W.; Haddon, William, Jr. and Eiswirth, Richard S.** "A Controlled Study of the Effect of Television Messages on Safety Belt Use." *American Journal of Public Health*, Vol. 64, No. 11 (November 1974), pp. 1071-1080.
217. **Robertson, Leon S. and Baker, Susan P.** "Prior Violation Records of 1447 Drivers Involved in Fatal Crashes." *Accident Analysis and Prevention*, Vol. 7, No. 2 (June 1975), pp. 121-128.

218. **Robertson, Leon S.** "Behavioral Research and Strategies in Public Health: A Demur." *Social Science and Medicine*, Vol. 9 (1975), pp. 165-170.
219. **Robertson, Leon S.** "Stress Research and the Amelioration of Human Problems." In *Systems Thinking and the Quality of Life, Proceedings of the Society for General Systems Research*, 1975. Washington: Society for General Systems Research, 1975.
220. **Robertson, Leon S.** "Factors Associated with Safety Belt Use in 1974 Starter-Interlock Equipped Cars." *Journal of Health and Social Behavior*, Vol. 16 (June 1975), pp. 173-177.
221. **Robertson, Leon S.** "Safety Belt Use in Automobiles with Starter-Interlock and Buzzer-Light Reminder Systems." *American Journal of Public Health*, Vol. 65, No. 12 (December 1975), pp. 1319-1325.
222. **Robertson, Leon S.** "Whose Behavior in What Health Marketplace?" *Consumer Behavior in the Health Marketplace: A Symposium Proceedings*, 1976 (Ian M. Newman, Editor). Lincoln: Nebraska Center for Health Education, University of Nebraska, 1976.
223. **Robertson, Leon S.** "An Instance of Effective Legal Regulation: Motorcyclist Helmet and Daytime Headlamp Use Laws." *Law and Society Review*, Vol. 10, No. 2 (Spring 1976), pp. 467-477.
224. **Robertson, Leon S.** *Automobile Seat Belt Use After the Interlock*. Washington: Insurance Institute for Highway Safety, June 1976.
225. **Robertson, Leon S.** "The Effects of New-Car Safety Regulation on Fatality Rates." *Best's Review*, Vol. 77, No. 3 (July 1976), pp. 22-24.
226. **Robertson, Leon S.** *Increased Motor Vehicle Crash Protection: Public Preference and Willingness to Pay*. Washington: Insurance Institute for Highway Safety, August 1976. Reprinted as "Study Shows Public Is Willing to Pay for Motor Vehicle Crash Protection," *The National Underwriter*, Sept. 3, 1976, pp. 15, 18.
227. **Robertson, Leon S. and Baker, Susan P.** "Motor Vehicle Sizes in 1440 Fatal Crashes." *Accident Analysis and Prevention*, Vol. 8, No. 3 (September 1976), pp. 167-175.
228. **Robertson, Leon S.** "Estimates of Motor Vehicle Seat Belt Effectiveness and Use: Implications for Occupant Crash Protection." *American Journal of Public Health*, Vol. 66, No. 9 (September 1976), pp. 859-864.
229. **Robertson, Leon S.** "The Great Seat Belt Campaign Flop: What Now?" *Journal of Communication*. Vol. 26, No. 4 (Autumn 1976), pp. 41-45.
230. **Robertson, Leon S.** "Evaluation of Community Programs." Presented at the Seventh International Conference on Alcohol, Drugs, and Traffic Safety, Jan. 28, 1977. Washington: Insurance Institute for Highway Safety, January 1977. (Proceedings to be published)
231. **Robertson, Leon S.** "The Seat Belt Use Law in Ontario, Canada: Effects on Actual Use." *Canadian Journal of Public Health*, in press.
232. **Robertson, Leon S.** "Car Crashes: Perceived Vulnerability and Willingness to Pay for Crash Protection." *Journal of Community Health*, in press.
233. **Robertson, Leon S.** "Automobile Seat Belt Use in Selected Countries, States and Provinces with and without Laws Requiring Belt Use." *Accident Analysis and Prevention*, in press.
234. **Robertson, Leon S.** "A Critical Analysis of Peltzman's 'The Effects of Automobile Safety Regulation.'" *The Journal of Economic Issues*, Vol. XI, No. 3 (September 1977), pp.
235. **Robertson, Leon S.** "Rejoinder to Peltzman." *The Journal of Economic Issues*, Vol. XI, No. 3 (September 1977), pp. 679-683.
236. **Robertson, Leon S.** "State and Federal New-Car Safety Regulation: Effects on Fatality Rates." *Accident Analysis and Prevention*, Vol. 9, No. 3-A (September 1977), pp. 151-156.
237. **Robertson, Leon S. and Zador, Paul L.** *Driver Education and Fatal Crash Involvement of Teenaged Drivers*. Washington: Insurance Institute for Highway Safety, April 1978.
238. **Ross, H. Laurence.** "The Scandinavian Myth: The Effectiveness of Drinking-and-Driving Legislation in Sweden and Norway." *The Journal of Legal Studies*, Vol. 4, No. 2 (June 1975), pp. 285-310.

239. **Ross, H. Laurence.** "Blood Alcohol Concentrations Among Scandinavian Drivers: Data from the Northern Countries in International Perspective." *Blutalkohol*, Vol. 12 (1975), pp. 372-381.
240. **Schaefer, Carl F.; Gunn, C. G. and Dubowski, Kurt M.** "Dose-Related Heart-Rate, Perceptual, and Decisional Changes in Man Following Marijuana Smoking." *Perceptual and Motor Skills*, Vol. 44, No. 1 (February 1977), pp. 3-16.
241. **Schneider, Lawrence W.; Foust, David R.; Bowman, Bruce M.; Snyder, Richard G.; Chaffin, Don B.; Abdelnour, Thomas A. and Baum, Janet K.** "Biomechanical Properties of the Human Neck in Lateral Flexion." SAE Paper No. 751156. *Proceedings of the Nineteenth Stapp Car Crash Conference*, Nov. 17-19, 1975, pp. 455-485. Warrendale, Pa.: Society of Automotive Engineers, 1975.
242. **Smart, Charles N. and Sanders, Claudia R.** *The Costs of Motor Vehicle Related Spinal Cord Injuries*. Washington: Insurance Institute for Highway Safety, 1976.
243. **Snyder, Richard G.; Chaffin, Don B.; Schneider, Lawrence W.; Foust, David R.; Bowman, Bruce M.; Abdelnour, Thomas A. and Baum, Janet K.** *Basic Biomechanical Properties of the Human Neck Related to Lateral Hyperflexion Injury*. Ann Arbor: Highway Safety Research Institute, University of Michigan, March 1975. Available from National Technical Information Service, Springfield, Va., order number PB 241 246.
244. **Snyder, Richard G. and O'Neill, Brian.** "Are 1974-1975 Automotive Belt Systems Hazardous to Children?" *American Journal of Diseases of Children*, Vol. 129 (August 1975), pp. 946-949.
245. **Snyder, R. G.; Chaffin, D. B. and Foust, D. R.** *Bioengineering Study of Basic Physical Measurements Related to Susceptibility to Cervical Hyperextension-Hyperflexion Injury*, Final Report. Ann Arbor: Highway Safety Research Institute, University of Michigan, September 1975.
246. **Snyder, Richard G.; Foust, David R. and Bowman, Bruce M.** *Study of Impact Tolerance Through Free-Fall Investigation*, Final Report. Ann Arbor: Highway Safety Research Institute, University of Michigan, Dec. 15, 1977.
247. **Trisko, Eugene M. and Shomo, Elwood W.** "A Study in Fire Department Cost Allocation." *Governmental Finance*, Vol. 3, No. 1 (November 1974), pp. 24-28, 33-36.
248. **Trisko, Eugene M.** "Results of the 1973 National Survey of Motor Vehicle Fires." *Fire Journal*, Vol. 69, No. 2 (March 1975), pp. 19-27.
249. **U.S. Congress. House. Committee on Interstate and Foreign Commerce.** *National Traffic and Motor Vehicle Safety Act Review and Renewal. Hearings before the Subcommittee on Commerce and Finance on H.R. 8190 and H.R. 11092, 91st Congress, 1st Session, 1969.* (Testimony of William Haddon, Jr., M.D. regarding funding of the Department of Transportation's safety program, March 24, 1969.)
250. **U.S. Congress. Senate. Committee on Commerce.** *Motor Vehicle Safety—1969. Hearings on S.1245, 91st Congress, 1st Session, 1969.* (Testimony of William Haddon, Jr., M.D. regarding funding of the Department of Transportation's safety program, April 15, 1969.)
251. **U.S. Congress. Senate. Committee on the Judiciary.** *Automotive Repair Industry, Hearings (Part II) before the Subcommittee on Antitrust and Monopoly, pursuant to S. Res. 40, 91st Congress, 1st Session, 1969.* (Testimony of William Haddon, Jr., M.D. regarding the cost of auto repairs, April 23, 1969.)
252. **U.S. Congress. House. Committee on Public Works.** *Highway Legislation. Hearings before the Subcommittee on Roads on H.R. 9446, H.R. 4808 (and related bills), H.R. 6785 (and related bills), and the Federal-Aid Highway and Highway Safety Programs, 91st Congress, 1st Session, 1969.* (Testimony of Albert Benjamin Kelley regarding the progress of the Highway Safety Act of 1966, June 5, 1969.)
253. **U.S. Congress. Senate. Committee on Public Works.** *Over-sight Hearings on the Highway Safety Program, Hearings before the Subcommittee on Roads, on Review of Programs Implementing the Requirements of the Highway Safety Act of 1966, and S. 2399, 91st Congress, 1st Session, 1969.* (Testimony of William Haddon, Jr., M.D. regarding funding and organization of the Department of Transportation's safety program, July 1, 1969.)
254. **U.S. Congress. Senate. Committee on the Judiciary.** *Automotive Repair Industry. Hearings (Part III) before the Subcommittee on Antitrust and Monopoly, pursuant to S. Res. 40, 91st Congress, 1st Session, 1969.* (Testimony of William Haddon, Jr., M.D. presenting results and films of the 1969 domestic low speed crash tests, October 6, 1969.) Reprinted in *Our Delicate Costly Cars*, pp. 5-10.

Bloomington, Ill.: State Farm Insurance Companies, 1969.

255. **U.S. Congress, Senate. Committee on the Judiciary.** *Automotive Repair Industry. Hearings* (Part IV) before the Subcommittee on Antitrust and Monopoly, pursuant to S. Res. 334, 91st Congress, 2nd Session, 1970. (Testimony of William Haddon, Jr., M.D. presenting results and films of the IIHS 1970 foreign and domestic auto low speed crash tests, March 17, 1970.)
256. **U.S. Congress. Senate. Committee on Appropriations.** *Department of Transportation and Related Agencies Appropriations for Fiscal Year 1971. Hearings* before the Subcommittee of the Committee on Appropriations on H.R. 17755, 91st Congress, 2nd Session, 1970. (Testimony of Albert Benjamin Kelley regarding increased federal funding for the National Highway Traffic Safety Administration, Aug. 24, 1970.)
257. **U.S. Congress. Senate. Committee on Commerce.** *Automobile Insurance Reform and Cost Savings. Hearings* (Part I) on S. 945, S. 946, S. 976, and S. Con. Res. 23, 92nd Congress, 1st Session, 1971. (Testimony of William Haddon, Jr., M.D. presenting the results and films of the IIHS 1971 domestic auto low speed crash tests, March 10, 1971.)
258. **U.S. Congress. Senate. Committee on Commerce.** *Automobile Insurance Reform and Cost Savings. Hearings* (Part IV) on S. 945, S. 946, S. 976, and S. Con. Res. 23, 92nd Congress, 1st Session, 1971. (Testimony of William Haddon, Jr., M.D. presenting the results and films of the IIHS 1971 foreign and domestic auto low speed crash tests, May 12, 1971.)
259. **U.S. Congress. Senate. Committee on Public Works.** *Oversight Hearings on the Highway Safety Program—1971. Hearings* before the Subcommittee on Roads, 92nd Congress, 1st Session, 1971. (Testimony of Albert Benjamin Kelley regarding roadside hazards, May 14, 1971.)
260. **U.S. Congress. House. Committee on Appropriations.** *Department of Transportation and Related Agencies Appropriations for 1972. Hearings* (Part III) before a Subcommittee of the Committee on Appropriations, 92nd Congress, 1st Session, 1971. (Testimony of Albert Benjamin Kelley regarding increased federal funding for the National Highway Traffic Safety Administration, May 26, 1971.)
261. **U.S. Congress. Senate. Committee on Appropriations.** *Department of Transportation and Related Agencies Appropriations for Fiscal Year 1972. Hearings* before the Subcommittee of the Committee on Appropriations on H.R. 9667, 92nd Congress, 1st Session, 1971. (Testimony of Albert Benjamin Kelley regarding appropriations for the highway safety program, July 1, 1971.)
262. **U.S. Congress. House. Committee on Interstate and Foreign Commerce.** *Automobile Property Damage and Consumer Information Program. Hearings* (Part II) before the Subcommittee on Commerce and Finance on H.R. 11627, H.R. 9353, H.R. 4999, S. 976 (and identical bills), 92nd Congress, 1st Session, 1971. (Testimony of William Haddon, Jr., M.D. presenting results and films of the IIHS 1971 foreign and domestic auto low-speed crash tests, Nov. 19, 1971.)
263. **U.S. Congress. Senate. Committee on Commerce.** *Auto Safety Repairs at No Cost. Hearings* on S. 355, 93rd Congress, 1st Session, 1973. (Testimony of William Haddon, Jr., M.D. presenting the results and films of the IIHS 1973 domestic auto low-speed crash tests, Jan. 31, 1973.)
264. **U.S. Congress. Senate. Committee on Public Works.** *Highway Safety Act of 1973. Hearings* before the Subcommittee on Transportation on S. 893, 93rd Congress, 1st Session, 1973. (Testimony of William Haddon, Jr., M.D. regarding roadside hazards and showing the IIHS film, *Boobytrap*, March 13, 1973.)
265. **U.S. Congress. House. Committee on Interstate and Foreign Commerce.** *Amendments to the National Traffic and Motor Vehicle Safety Act of 1966. Hearings* (Part I) before the Subcommittee on Commerce and Finance on H.R. 7505, H.R. 5529, S. 355, and H.R. 4187 (and all identical or similar bills), 93rd Congress, 1st Session, 1973. (Testimony of William Haddon, Jr., M.D. presenting the results and films of the IIHS 1973 foreign and domestic auto low-speed crash tests, March 23, 1973. And presenting testimony to a special meeting of the Subcommittee convened to hear the results of IIHS research on the crashworthiness of auto fuel systems and to see the IIHS film, *Cars that Crash and Burn*, May 29, 1973.)
266. **U.S. Congress. House. Committee on Interstate and Foreign Commerce.** *Motor Vehicle Information and Cost Savings Act Oversight. Hearings* before the Subcommittee on Commerce and Finance on Motor Vehicle Damageability Standards and Test Results, 93rd Congress, 2nd Session, 1974. (Testimony of William Haddon, Jr., M.D. present-

- ing the results and films of the IIHS 1974 domestic auto low-speed crash tests, Jan. 28, 1974.)
57. **U.S. Congress. Senate. Committee on Commerce. Motor Vehicle Safety Oversight. Hearings on Motor Vehicle Safety Oversight, 93rd Congress, 2nd Session, 1974.** (Testimony of William Haddon, Jr., M.D. presenting the results and films of the IIHS 1974 foreign and domestic auto low-speed crash tests, March 28, 1974.)
 58. **U.S. Congress. Senate. Committee on Commerce. Motor Vehicle Information and Cost Savings Act Oversight. Hearings before the Subcommittee for Consumers, 94th Congress, 1st Session, 1975.** (Testimony of Albert Benjamin Kelley presenting results and films of IIHS low-speed crash tests, March 14, 1975.)
 59. **U.S. Congress. House. Committee on Interstate and Foreign Commerce. National Traffic and Motor Vehicle Safety Act Amendments. Hearings before the Subcommittee on Consumer Protection and Finance on H.R. 9291, 94th Congress, 2nd Session, 1976.** (Testimony of Albert Benjamin Kelley regarding federal air brake standard, March 3, 1976.)
 60. **U.S. Congress. Senate. Committee on Commerce. Automobile Crash Parts. Hearings before the Subcommittee for Consumers, 94th Congress, 2nd Session, 1976.** (Testimony of William Haddon, Jr., M.D. regarding the delicateness of cars in low speed impacts and the influence of the federal safety standard for exterior protection, March 8, 1976.)
 71. **U.S. Congress. House. Committee on Interstate and Foreign Commerce. National Traffic and Motor Vehicle Safety Act Amendments. Hearings before the Subcommittee on Consumer Protection and Finance on H.R. 9291, 94th Congress, 2nd Session, 1976.** (Testimony of William Haddon, Jr., M.D. and Albert Benjamin Kelley regarding protection of vehicle occupants in crashes, March 12, 1976.)
 72. **Van Eck, Peter J.; Chaffin, Don B.; Foust, David R.; Baum, Janet K. and Snyder, Richard G. A Bibliography of Whiplash and Cervical Kinematic Measurement.** Ann Arbor: Highway Safety Research Institute, University of Michigan, 1973. Available from National Technical Information Service, Springfield, Va., order number PB 225 203/9.
 273. **Vinson, Joe; Patel, Dinu and Patel, Arun.** "Detection of Tetrahydrocannabinol in Blood and Serum Using Fluorescent Derivative and Thin-Layer Chromatography." *Analytical Chemistry*, Vol. 49, No. 1 (January 1977), pp. 163-165.
 274. **Waller, Julian A.; Harris, Lawrence S. and Oprendeck, John J., Jr.** *Booby-Trapped Highways in the "Beckoning Country."* Washington: Insurance Institute for Highway Safety, 1970.
 275. **Waller, Julian A.** "The Role of Alcohol in Collisions Involving Trucks and the Fatally Injured." *Archives of Environmental Health*, Vol. 20 (February 1970), pp. 254-258.
 276. **Waller, Julian A. and Jacobs, L.** *Ambulance Service in Vermont.* Burlington: University of Vermont, 1971.
 277. **Waller, Julian A.** "Factors Associated with Police Evaluation of Drinking in Fatal Highway Crashes." *Journal of Safety Research*, Vol. 3, No. 1 (March 1971), pp. 35-41.
 278. **Waller, Julian A. and Thomas, Kenneth.** "Carbon Monoxide, Smoking and Highway Crashes." *Proceedings of the Fifteenth Conference of the American Association for Automotive Medicine*, Oct. 20-23, 1971, pp. 245-260. Warrendale, Pa.: Society of Automotive Engineers, 1972.
 279. **Waller, Julian A.** "Highway Booby Traps: M.D.'s Must Speak Out." *Medical Tribune*, Vol. 12, No. 44 (November 10, 1971), p. 6.
 280. **Waller, Julian A.** "Factors Associated with Alcohol and Responsibility for Fatal Highway Crashes." *Quarterly Journal of Studies on Alcohol*, Vol. 33, No. 1 (March 1972), pp. 160-170.
 281. **Waller, Julian A.; Lamborn, Kathleen R. and Steffenhagen, Ronald A.** "Marijuana and Driving Among Teenagers: Reported Use Patterns, Effects, and Experiences Related to Driving." *Accident Analysis and Prevention*, Vol. 6, No. 2 (October 1974), pp. 141-161.
 282. **Williams, Allan F. and O'Neill, Brian.** "On-the-Road Driving Records of Licensed Race Drivers." *Accident Analysis and Prevention*, Vol. 6, No. 34 (December 1974), pp. 263-270.
 283. **Williams, Allan F.; Rich, Robert F.; Zador, Paul L. and Robertson, Leon S.** "The Legal Minimum Drinking Age and Fatal Motor Vehicle Crashes." *Journal of Legal Studies*, Vol. 4, No. 1 (January 1975), pp. 219-239.

284. Williams, Allan F. and Robertson, Leon S. "The Fatal Crash Reduction Program: A Reevaluation." *Accident Analysis and Prevention*, Vol. 7, No. 1 (May 1975), pp. 37-44.
285. Williams, Allan F. "Factors in the Initiation of Bicycle-Motor Vehicle Collisions." *American Journal of Diseases of Children*, Vol. 130 (April 1976), pp. 370-377.
286. Williams, Allan F. and Zador, Paul. "Injuries to Children in Automobiles in Relation to Seating Location and Restraint Use." *Accident Analysis and Prevention*, Vol. 9, No. 1 (March 1977), pp. 69-76.
287. Williams, Allan F. "Air Bags and Out-of-Position Children—A Survey." *Accident Analysis and Prevention*, Vol. 8, No. 2 (June 1976), pp. 143-144.
288. Williams, Allan F. "Observed Child Restraint Use in Automobiles." *American Journal of Diseases of Children*, Vol. 130, No. 12 (December 1976), pp. 1311-1317.
289. Williams, Allan F. "Feasibility of Determining Blood Alcohol Concentrations in Social Drinking Settings." *Journal of Studies on Alcohol*, Vol. 39, No. 1 (January 1978), pp. 201-206.
290. Williams, Allan F. *Warning: In Cars, Parents May Be Hazardous to Their Children's Health*. Washington: Insurance Institute for Highway Safety, March 1978.
291. Wolfe, G. K.; Bronstad, M. E.; Michie, J. D. and Wong, Jackson. "A Breakaway Concept for Timber Utility Poles." *Transportation Research Record* No. 488. Washington: Transportation Research Board, 1974.
292. Wong, Jackson. "Roadside Hazards: An Introduction." In *Key Issues in Highway Loss Reduction: Proceedings of the Insurance Institute for Highway Safety 1970 Symposium*, Washington, D.C., June 9-10, 1970, edited by Charles W. Wixom, pp. 79-104. Washington: Insurance Institute for Highway Safety, 1970.
293. Wong, Jackson. *Statement Before the Vehicle Equipment Safety Commission on Minimum Requirements for Construction and Equipment of Mopeds*. Washington: Insurance Institute for Highway Safety, May 11, 1977.
294. Woodhouse, Edward J. "Confirmation of the Presence of 11-Hydroxy-9-Tetrahydrocannabinol in the Urine of Marijuana Smokers." *American Journal of Public Health*, Vol. 62, No. 10 (October 1972), pp. 1394-1396.
295. Wright, Paul H. and Robertson, Leon S. "Priorities for Roadside Hazard Modification." *Traffic Engineering*, Vol. 46, No. 8 (August 1976), pp. 24-30. Reprinted as: "Priorities for Roadside Hazard Modification: A Study of 300 Fatal Roadside Object Crashes," *Proceedings of the Twentieth Conference of the American Association for Automotive Medicine*, Nov. 1-3, 1976, pp. 114-127. Morton Grove, Ill.: American Association for Automotive Medicine, 1976. Reprinted as: "Studies of Roadside Hazards for Projecting Fatal Crash Sites," *Transportation Research Record* 609. Washington: National Academy of Sciences, 1976.
296. Young, G. Stewart and Baker, Susan P. "Recent Trends in Childhood Burn Deaths." Presented at the 104th Annual Meeting of the American Public Health Association Meeting, Oct. 19, 1976. Baltimore: Johns Hopkins School of Hygiene and Public Health, 1976.
297. Zador, Paul L. "Statistical Evaluation of the Effectiveness of Alcohol Safety Action Projects." *Accident Analysis and Prevention*, Vol. 8, No. 1 (February 1976), pp. 51-66.
298. Zador, Paul L. "A Rejoinder to 'A Critique of the Paper "Statistical Evaluation of the Effectiveness of Alcohol Safety Action Programs" by Johnson, et al.'" *Accident Analysis and Prevention*, Vol. 9, No. 1 (March 1977), pp. 15-19.
299. Zaremba, Loren A. and Ginsburg, Marvin J. "The 55 MPH Limits and Front-to-Rear Collisions Involving Autos and Large Trucks." *Accident Analysis and Prevention*, Vol. 9, No. 4 (December 1977), pp. 303-314.
300. Zaremba, Loren A.; Wong, Jackson and Mcfaff, Charles. *Eliminating Automobile Occupant Compartment Penetration in Moderate Speed Truck Rear Underride Crashes: A Crash Test Program*. Washington: Insurance Institute for Highway Safety, April 1977.

Program Index

Advertising

see SAFETY CAMPAIGNS

Aetna Life and Casualty, 56

Age

Bicycle-motor vehicle collisions and, 51

Minimum legal drinking, 10-11

Motorcycle use and, 49

Pedestrian fatalities and, 51

Severe injury deaths related to, 48

Air Bags

see RESTRAINT SYSTEMS

Alcohol

"Alcohol Safety Action Programs" (ASAP), 12

Blood concentrations, 7-8, 56-57

Carbon monoxide poisoning and, 56-57

Jail sentences for drunk driving, 11-12

Minimum legal drinking age, 10-11

Motorcycle crash involvement, 8-9

Pedestrian fatalities involvement, 51

Scandinavian drunk driving laws, 11

Serum osmolality tests, 7

Tests, 7-9

Truck crash involvement, 8

Allstate Insurance Company, 56, 63

Ambulance Service

see EMERGENCY CARE

American Insurance Highway Safety Association, 62

American Insurers Highway Safety Alliance, 62

Anthropomorphic Dummies, 27

Arnold & Porter, 43

Australia

Mandatory safety belt use laws, 20

Behavior Modification

Pedestrian injuries and, 51

Bicycles, 51

Birmingham, University of, 31-32

Breed Corporation, 37

Bumpers

see CRASHWORTHINESS; DESIGN DEFICIENCIES

California, University of, 49, 52

Carbon Monoxide, 56-57

Center for the Environment and Man, 57-58

Chicago, University of, 12

Children

Pedestrian fatalities, 51

Restraint systems, 28-31

Chubb & Son, Inc., 62

Cost Benefit Analysis

Applicability to vehicle performance standards, 57-58

Bumper designs and, 54

Crash Loss Data, 54-56

Crash Recorders, 37

Crash Test

Air bag, 21

Bumpers, 35-36

Dummy design, 21, 27

Films, 21, 32, 35, 38, 47

Fires, 46-47

Fuel tank, 46-47

Hoods, 40

Low-speed, 35-36

Recorders, 37

Size factors, 32

Underride, 38-39

Crashes

Air bags and, 28, 30

Alcohol-related, 8-9, 12

Bicycles with motor vehicles, 51

Damage repair, 54

Emergency care, 46

Fires, 46-47

Habitual offender involvement, 13-14

Injuries, 23, 27, 29-30, 41, 52

Motorcycle, 8-9, 32-33

Ownership of vehicles involved in, 26

Reduction, 18-19, 58-59

Roadside hazards and, 43-44

Size factors, 32-34

Teenage involvement, 16-17

Truck, 8, 20, 32-34, 40

Underride, 38-39

Crashworthiness

Bumpers, 35-36

Fuel systems, 46-47

Low-speed impacts, 35-36

"Meat-axe" hoods, 40

Vehicle size and injury losses, 54-55

Vehicle size and weight and crash tests, 32-34

Damage

- Control and reduction, 58-59
- Design deficiencies and vehicle, 35-36
- Low-speed impact, 35-36
- Property damage standards, 57
- Replacement parts, 35
- Unrepaired, 54

Daytime

- Bicycle-motor vehicle collisions, 51
- Vehicle crashes in ASAP areas, 12

Defects, Vehicle

- see also DESIGN DEFICIENCIES
- Fuel line clamps, 19
- Fuel tank leaks, 19
- Steering control, 19

Denver, University of, 11,12

Design Deficiencies

- see also DEFECTS, VEHICLE
- Bumper and hood, 31-32
- Carbon monoxide poisoning and, 56-57
- Fires resulting from, 46-47
- Low-speed impact and, 35-36
- Trucks, 40-41

Drivers

- Education, 16-17
- Female, 27, 49
- Habitual offenders, 13
- License suspension, 14
- Male, 27, 49
- Race car, 15

Drugs

- see also ALCOHOL
- Driving affected by, 9
- Testing for use of, 7-8

Emergency Care, 47

"Fatal Accident Reduction Enforcement Program" (FARE), 19

"Fatal Crash Reduction Program," 19

Fatalities

- Carbon monoxide, 56-57
- Control and reduction of, 58-59
- Crash fires and, 46-47
- Decrease due to mandatory safety belt use in Australia, 20
- Drinking age effect on, 10-11
- Driver education and, 16-17
- Drunk driving crackdown effect on, 12
- Economic evaluations of, 58

Emergency care and, 46

- Motorcycle, 49-50
- Pedestrian, 49
- Restraint system use effect on, 20-26, 41-42
- Spinal cord injury and, 52-53
- Vehicle size and weight and, 32-34

Federal Highway Trust Fund, 43

Federal Motor Vehicle Safety Standards

- Bumpers, 36
- Cost-benefit analyses applied to, 57-58
- Fuel tank design, 46-47
- Head restraints, 27
- Hoods, 40
- Trucks, proposed underride protection, 38-39

Fire Department Costs, 46-47

Georgia Institute of Technology, 44

Government Employees Insurance Company, 56

Habitual Offenders, 13

Harvest Films, 43, 47

Head Restraints

- see RESTRAINT SYSTEMS

Helmets

- see MOTORCYCLES

Highway Loss Data Institute, 22, 54-56

Home Insurance Company, 56, 63

Illinois, University of, 46

Injuries

- Abbreviated Injury Scale, 48
- Abdominal, 23, 46, 49
- Back, 27
- Control and reduction of, 58-59
- Crash fires and, 46-47
- Drinking age effect on, 10
- Emergency care, 47
- Facial, 47
- Head, 49
- Injury Severity Score, 48
- Motorcyclists, 49-50
- Neck, 23, 27
- Pedestrian, 31-32
- Reduction, 27
- Restraint systems effect on, 20-26
- Spinal cord, 52-53
- Vehicle size and weight and, 32-34
- Whiplash, 27

Insurance

- Companies and HLDI, 54-56
- Design deficiency costs, 35-36
- Master Driver License effect on cost, 15
- Restraint system use effect on claims, 22
- Spinal cord injury costs, 53
- Unreported damage to vehicles, 54
- "Vindicator" loss data collection and analysis system, 54-56

International Association of Chiefs of Police, 44

Johns Hopkins University, 13, 14, 33, 47, 48, 51, 56

Kemper Insurance and Financial Companies, 56, 62

"The Law and Roadside Hazards," 43

Laws

- Drunk driving, enforcement of, 12
- Habitual traffic offender, 13
- Minimum legal drinking age, 10-11
- Motorcycle helmet and headlamp use, 50
- Motor Vehicle Information and Cost Savings Act of 1972, 35
- Roadside hazards, 43-44
- Safety belt mandatory use, 20-22
- Scandinavian drunk driving, 11
- Vehicle fuel tank standards, 46-47

Liberty Mutual Insurance Company, 56, 62

License

see DRIVER

License Plate Screening, 18

Loss Reduction, 58-59

Make/Model Studies, 54

Marijuana, 8

see also DRUGS

Maryland Institute for Emergency Medicine, 48

Maryland Medical-Legal Foundation, 8, 40, 47

Maryland Motor Vehicle Administration, 18

Master Driver License Program, 15

"Meat-axe" Hoods, 40

Michigan, University of,

Highway Safety Research Institute, 27

Motor Vehicle Information and Cost Savings Act of 1972, 35

Motorcycles

- Driver injuries and fatalities, 49-50
- Drunk driving, 8-9
- Helmet and headlamp use law, 49-50
- Spinal cord injuries of drivers, 52
- Vehicle size and weight and crashes, 32-34

Nathan, Robert N., Associates, 47

National Association of Independent Insurers, 19

National Association of Independent Insurers Safety Association, 63

National Highway Traffic Safety Administration

- Alcohol Safety Action Programs, 12
- Crash fires, proposal of standards to reduce, 46-47
- Fatal Accident Reduction Enforcement Program (FARE), 19
- Fatal Crash Reduction Program, 19
- Fuel system proposal, 46-47
- Master Driver License program proposal, 15
- "Meat-axe" hood study reported to, 40
- Passive restraint standards hearings, 26
- Steering assembly standards for trucks proposal, 41
- Steering control defects reported to, 40-41

Nationwide Mutual Insurance Company, 56, 63

Nighttime

- Crashes in ASAP areas, 12
- Drivers under 21, 10

North Carolina, University of,

Highway Safety Research Center, 32, 41

North Dakota State University, 7

Oklahoma, University of, 7-8

Passive Restraints

see RESTRAINT SYSTEMS, SAFETY BELTS

Pedestrians

- Design deficiencies affecting injury of, 31-32
- Fatalities, 49
- Federal safety standards effect on fatalities, 41-42
- Spinal cord injuries, 52-53
- Motorcycle-related injuries underreported, 49

Police

- Motorcycle-related injuries underreported by, 49
- Roadside hazard identification by, 44
- Vehicle screening, 18

Prudential Property and Casualty Insurance Company, 56, 63

Race Drivers, 15

Restraint Systems

- see also, SAFETY BELTS
- Air bags, 20-26, 28-31
- Buzzer-light, 20-21
- Child restraints, 28-31
- Effectiveness, 20-26
- Federal standards effectiveness, 41-42
- Head restraints, 27

Roadside Hazards, 43-44

Safeco Insurance Companies, 63

Safety Belts

"Active" systems, 20, 22-23, 28-31

Lap, 41-42

Loss reduction affected by, 54-55

Mandatory use laws, 20-22

"Passive" restraints, 20-26, 28-31, 55

Shoulder harness, 22-23

Starter-interlock system, 21

Trucks, use in, 41

Safety Campaigns

Alcohol Safety Action Programs (ASAP), 12

Fatal Accident Reduction Enforcement Program (FARE), 19

Fatal Crash Reduction Program, 19

Pedestrian injury affected by, 51

Restraint system use affected by, 20, 22-23

Scandinavia, 11

Sentry Insurance, A Mutual Company, 62

Southern California Research Institute, 9

Spinal Cord Injury

see INJURIES

Sports Car Club of America, 15

State Farm Mutual Insurance Company, 27, 54, 56, 63

"Status Report," 5, 26

"TAGS" Program, 18

Travelers Insurance Company, 56, 62

Trucks

Design deficiencies, 40-41

Drunk driving, 8

Underride collisions, 38-39

Vehicle size and weight and crashes, 32-34

United Services Automobile Association, 56, 63

U.S. Congress

House Commerce Committee, 47

House Subcommittee on Consumer Protection and Finance, 35

Senate Consumer Subcommittee, 35, 38

Senate Public Works Committee, 43

U.S. Department of Transportation

Breath alcohol testing instrument development, 7

Crashworthiness standards, 35

Safety belt use results, 23

Vehicle

see also TRUCKS

Crash recording equipment, 37

Design, see DESIGN DEFICIENCIES

Fires, see CRASHWORTHINESS

Loss characteristics, 54-55

Size and weight, see CRASHWORTHINESS

Vehicle Equipment Safety Commission, 38

Vermont, University of, 47

"Vindicator," 54

Whiplash, 27